SDMS DOCID# 1110502

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08/08/2006 11:20 AM

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Subject Revised SVE Pilot Test Work Plan

Hi Chris - on behalf of OPOG and as requested by Ed Modiano, the Revised SVE Pilot Test Work Plan (CDM, August 4, 2006) is attached for your review. I've attached both a redline pdf file showing all changes, and a final pdf version with all changes accepted. If you have any questions, please feel free to call me (Ed is out of town and on vacation this week).

Regards, Sharon

SVE Pilot WP 8_4_06 Redline.pdf SVE Pilot WP 8_4_06.pdf

Omega Chemical Site

Soil Vapor Extraction Pilot Test Work Plan

August 4, 2006

Prepared for:

Omega Chemical Site PRP Organized Group

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Project No. 10500-37240-T2.OSS.SVEPILOT

Contents

List of Figures

List of Tables

Appendices

Section 1
Introduction

1.1 Scope of Work

Camp Dresser & McKee Inc. (CDM) has prepared this work plan on behalf of the Omega Chemical Site Potentially Responsible Party (PRP) Organized Group (OPOG) to pilot test soil vapor extraction (SVE) at the Omega Chemical Site (Site). This document has been prepared in accordance with the Statement of Work in Consent Decree (CD) No. 00-12471 between the United States Environmental Protection Agency (EPA) and OPOG. The CD was lodged on November 24, 2000 and entered into the US District Court on February 28, 2001.

The pilot test is being conducted to collect data confirm the feasibility of SVE and to assist in the design and implementation of a potential full-scale SVE system at the Site, if appropriate. The primary VOCs at the Site and adjacent parcels are tetrachloroethene (PCE), trichloroethene (TCE), 1,1-dichloroethene (1,1-DCE), Freon 113, and Freon 11.

This work plan describes the pilot testing that will be performed to provide a basis for design for a potential full-scale SVE on the Omega site. This document supersedes the draft work plan submitted to the EPA on November 30, 2004 and the revision dated December 28, 2004, and incorporates responses to EPA comments on previous drafts, as appropriate.

1.2 Site Introduction and Background

This section provides a brief summary of applicable site conditions. A more complete description can be found in the *On-Site Soils (OSS) Remedial Investigation/Feasibility Study (RI/FS) Work Plan* (CDM September 29, 2003).

The Site is located at 12504/12512 East Whittier Boulevard in Whittier, California. The site was developed in 1951 and occupies Los Angeles County Assessor Tract No. 13486, Lots 3 and 4. The Site is approximately 41,000 square feet in area (200 feet wide by 205 feet long) and contains two structures – an approximate 140-foot by 50-foot warehouse and an approximate 80-foot by 30-foot administrative building. A loading dock is also attached to the rear of the warehouse. The exterior areas are concrete-paved and the site is secured with a perimeter fence and locking gate. The Site is currently occupied by two tenants – Star City Auto Body located in the northern portion (consisting of warehouse and exterior parking lot) and 3 Kings Construction in the southern portion (consisting of small office building and exterior parking lot).

Adjacent and Nearby Properties

One commercial property (Skateland) and two industrial properties (Medlin & Son and Terra Pave) are located immediately adjacent to the Site (southeastern, northwestern, and southwestern boundaries, respectively). The three commercial/

industrial properties immediately adjacent to the Site and other nearby properties are discussed below.

Skateland is located on Whittier Boulevard, adjacent to the southeastern boundary of the Site. The property consists of an indoor roller-skating rink that is currently in operation and is open to the general public.

The Terra Pave, Inc. facility is located at 12511 East Putnam Street, adjacent to the southwestern boundary of the Site. New England Lead Burning Company (NELCO) reportedly operated the property beginning in the mid-1950s. NELCO purchased lead in sheet, pipe and solid rods and fabricated the desired product by burning (welding) the lead to the required shape. The welding was performed in the building located along the northeastern portion of the property. Undeveloped portions of the property consisted of exposed soil and miscellaneous rubble.

The Medlin & Son (formerly, Cal-Air) facility is located at 12484 Whittier Boulevard, adjacent to the northwestern boundary of the site. A machine shop and office were reportedly constructed at the property in 1954. In September 1976, Cal-Air Conditioning Company added three new offices and occupied the property until 1996. Medlin & Son currently operate a machine shop at the property, producing specialty small metal parts.

Local Hydrogeology

The site is underlain by low permeability silty and clayey soils of the upper Pleistocene Lakewood Formation, probably representing the Bellflower aquiclude, to a depth of at least 120 feet bgs. The term "aquiclude" is used in the published literature, but "aquitard" is a more accurate description of this stratigraphic unit. Soils underlying the site consist primarily of fine-grained materials (e.g., clayey silts and silty clays).

Depth-to-water in on-Site well OW-1 was measured at 75.33 feet below ground surface (bgs) during the most recent semi-annual sampling event in February 2006. A coarser-grained sandy layer, probably representing the Gage aquifer, was encountered southwest of the facility along and downgradient of Putnam Street, but was not detected beneath the Site. Observations made during sampling events performed from 1999 to the present indicate a consistent direction of groundwater flow to the southwest.

Well OW-1b (screened from 110 to 120 feet bgs), located at the adjacent Terra Pave property, was designed as a deeper companion well to on-Site well OW-1. The subsurface materials at location OW1b were very uniform and consisted of fine-grained materials (silty clays) throughout the entire drilled depth of the boring (131.5 feet bgs). Some gravel imbedded in the silty clay matrix was observed in the interval from 125 to 130 feet bgs. During the February 2006 semi-annual sampling event, depth-to-water was measured at 75.77 feet bgs in well OW-1b. Observations made during sampling events performed from 1999 to the present indicate a consistent direction of groundwater flow to the southwest.

The Report Addendum for Additional Data Collection in the Phase 1a Area (CDM, June 27, 2003) was revised to include the results of additional investigation performed by OPOG (e.g., aquifer testing, well installation, groundwater and soil sampling, etc.). The revised report includes detailed cross-sections illustrating subsurface lithology beneath and downgradient of the Site.

1.3 Soil Vapor Extraction Technology Description

SVE is an *in situ* remediation technology that removes VOCs and some semi-volatile organic compounds (SVOCs) from vadose zone and capillary fringe soils. SVE withdraws vapor from the subsurface using vacuum blowers and vapor extraction wells. The contaminated vapors are typically collected at the surface and treated and/or discharged to the atmosphere. The induced advection of air draws clean air through the contaminated vadose zone, promoting transfer of contaminants from the subsurface soil matrix to the vapor phase. In addition, SVE may stimulate aerobic biological degradation of the contaminants by increasing the oxygen content of the soil vapor.

A SVE system typically consists of a blower, a control panel, an air-water separator, a particulate filter, valving, gauges, piping, and a vapor treatment system. The type of vapor treatment system selected is based on the nature and concentrations of the contaminants.

1.4 Types of Testing

The SVE pilot testing will consist of two types of tests: step testing and a multi-week pilot test. The step testing will be performed to evaluate the relationship between applied vacuum at the SVE wells and 1) the resulting vapor flows; and 2) the resulting vacuum distributions in the subsurface around the wells. The multi-week test is intended to provide design information for potential implementation of the SVE technology once near-equilibrium conditions have been established by operating the SVE system for several weeks. Several weeks of operation are appropriate since vacuum distribution is slow to develop in low permeability soils such as those found at the Site.

1.5 Pilot Test Objectives

The overall objectives of the proposed SVE pilot test are to collect additional data which will be used in the selection, design, and implementation of the overall on-site soils remedy for the Omega site. Specifically, the collected data will aid in selecting the most appropriate SVE design parameters for a potential full-scale system at the site.

Specific objectives for this pilot test include:

- Confirm the feasibility of SVE for site conditions above the 30 foot clay unit (the 30 foot sand unit and the overlying silt).

- Confirm the ability of vapor phase granular activated carbon (GAC) and condensation technology to treat extracted vapors to appropriate discharge limits.

- Estimate the contaminant mass removal rate in extracted vapors to size and select the treatment systems for a potential full-scale system and to evaluate air discharge permit issues.

- Estimate the achievable SVE treatment zone sizes for the 30 foot sand interval and the shallower interval above this sand unit to serve as a basis to select well spacing and construction.

- Provide VOC mass removal data from SVE wells screened in two intervals to help in determining the VOC vertical distribution in the vadose zone above the 30 foot clay unit.

Section 2
Pilot Test Design and Procedures

2.1 Test Apparatus

This section describes the wells and remedial equipment that will be used to perform and monitor the pilot testing. All work will be performed in accordance with the procedures detailed in this document and in the *OSS RI/FS Work Plan* (CDM, September 29, 2003). In addition, the *OSS Work Plan Addendum, Scope of Work for Additional Investigation* (CDM, October 20, 2004) will also be followed, as appropriate.

2.1.1 SVE/Monitoring Wells

The proposed location of the testing is the lot behind the 3 Kings building. The rationale for selecting this location includes:

- High contaminant concentrations exist at all pertinent vadose sampling depths in this area
- The area is secured by fencing
- The area is big enough to accommodate all equipment and wells without significant disruption to on-going business activities

The area to the southwest of Star City Auto Body was also a candidate site for the testing based on the high soil vapor concentrations there; however, it was not selected due to security issues and to avoid disruption to the business at that building.

Ten new SVE/monitoring wells are proposed to be installed on the Site for pilot testing. Each of these wells will be capable of being used as a SVE well or as a vacuum monitoring point when other well(s) are operating. Proposed locations of the new SVE/monitoring wells are shown in Figure 2-1, although the exact locations may vary depending on site constraints and access agreements. The wells have been positioned based on previous SVE experience in similar soil conditions which indicates that the treatment zone radius in the shallow, silty soils will likely be approximately 30 feet. There are not any existing soil vapor probes in the SVE pilot test area and since the membrane interface probe (MIP)/soil vapor monitoring program is completed, it is not anticipated that additional vapor probes will be installed.

These new SVE wells will be installed using hollow stem auger drilling methods and will be constructed of 4-inch diameter PVC casing. Each borehole will be continuously sampled using a core barrel or split spoon to document the soil profile at each location. Five shallow SVE/monitoring wells will be screened from 12 to 22 feet. Five SVE/monitoring wells will target the sand layer that exists above the "30 foot clay". The total depth of these SVE/monitoring wells will be approximately 36 feet, with a screened interval over the lower 10 feet. Surfaces at each location will be completed with a flush-grade, water-tight, traffic-rated surface completion. Figure 2-2 depicts the proposed SVE screened intervals.

The proposed SVE wells target soils above the 30 foot clay layer since these are the soils that contain contaminants that may migrate upwards and pose a risk to indoor air quality in adjacent buildings. Deeper soils are not considered to be a significant risk to indoor air quality due to the barrier to upward soil vapor transport posed by the 30 foot clay layer. The deeper soil (i.e., below the 30 foot clay layer to the water table) will be evaluated as part of the Feasibility Study.

2.1.2 Process Equipment

SVE Equipment A subcontractor will supply a SVE unit housed in a walk-in container. The SVE unit will consist of a vacuum pump capable of extracting approximately 100 standard cubic feet per minute (scfm) at a vacuum of up to approximately 24 inches of mercury. These specifications were developed to achieve a minimum radius of influence (ROI) for each SVE well of approximately 30 feet; actual ROIs will be determined during the pilot test. The unit will have an air/water separator, a particulate filter, and vacuum and flow gauges. Spill containment will be provided for the air-water separator. A schematic of the SVE pilot system is presented in Figure 2-3.

Vapor Treatment Based on soil vapor data collected to date, total VOCs (including Freons) in the range of 3,500 to 4,000 milligrams per cubic meter (mg/m^3) and Freons in the range of 2,000 to 2,500 mg/m^3 may be encountered. The initial VOC concentrations will decrease substantially over time of SVE operations, therefore, two vapor treatments will be tested: GAC and a condensation-based technology supplied by GEO Inc. A condenser unit is a desirable alternative to thermal oxidation for high VOC concentration treatment (due to potential negative public perception issues regarding thermal oxidation).

GAC will be used to treat vapors for the majority of the test, with approximately two weeks of testing for the condensation unit during the multi-week testing. When the condensation treatment system is tested, it is likely that a different SVE blower unit will be used for that time. That is, the condensation pilot unit will be provided as a complete package to perform SVE and vapor treatment. The SVE unit associated with the condensation unit will also be capable of providing at least 100 scfm and 24 inches of mercury vacuum capacity. As shown on Figure 2-4, the condensation unit will have GAC as a polishing step prior to atmospheric discharge. If dilution air is needed, a flow meter will be used to measure the flow of dilution air.

GAC treatment results from before and after the condensation testing will be compared to the condensation treatment results to compare the two treatments under similar influent conditions.

The following describes how the condensation technology operates (more detail is provided in Appendix A):

- Soil gas is drawn into the system and delivered to an air compressor by a 5- to 10-horsepower positive displacement blower.

- Entrained liquids are separated at a water knockout tank.
- Process air is compressed to10 atmospheres (atms) by a compressor and then cooled to approximately 40° F in an after-cooler.
- Water vapor is removed from the process stream at air-to-air heat exchangers.
- Gas and vapor stream temperature is reduced to approximately -50° F in refrigerated heat exchangers, where the majority of the chemical constituents are condensed and separated from the vapor stream.
- Process gas and vapor stream is then sent to a regenerative adsorber, which removes remaining contaminants and water vapor and directs it back to the inlet stream.
- The air stream [<10 parts per million by volume (ppmv)] is finally polished by granular activated carbon (GAC) prior to discharge to atmosphere at <1 ppmv.

The effluent of the adsorber unit is constantly monitored with an organic vapor analyzer (OVA). The unit can be used in similar applications for many years without fouling or degradation. If it should become fouled, the OVA will detect this and it can be replaced. The spent adsorbent will be removed by a GAC manufacturer and recycler.

Power requirements for the 100 cfm condenser system are:

- 440 VAC 3 phase 100 AMP plus 220 VAC single phase 60 AMP or
- 220 VAC 3 phase 150 AMP

Actual power consumption is approximately 40 KVA/month. The GEO system is designed to operate 24 hours a day unattended. The system will automatically shut down if power fluctuations or internal malfunctions (e.g., high gas temperature after the air compressor, high temperature prior to regeneration system, high liquid levels in the knock-out water container, the separate phase liquid container and the condensate container, high pressure shutoff prior to condensing system, or high pressure shutoff prior to VOC collection drums) occur.

Spill containment will be provided for the air-water separator and water tank. Flame arrestors are not necessary as the VOCs to be recovered are not flammable (with the exception of a few VOCs that will be present in trace amounts).

2.2 Test Procedures

This section describes the locations, frequency, and parameters that will be monitored during the testing. Sampling methods and frequencies are described in Section 3.

2.2.1 Pre-Test Measurements

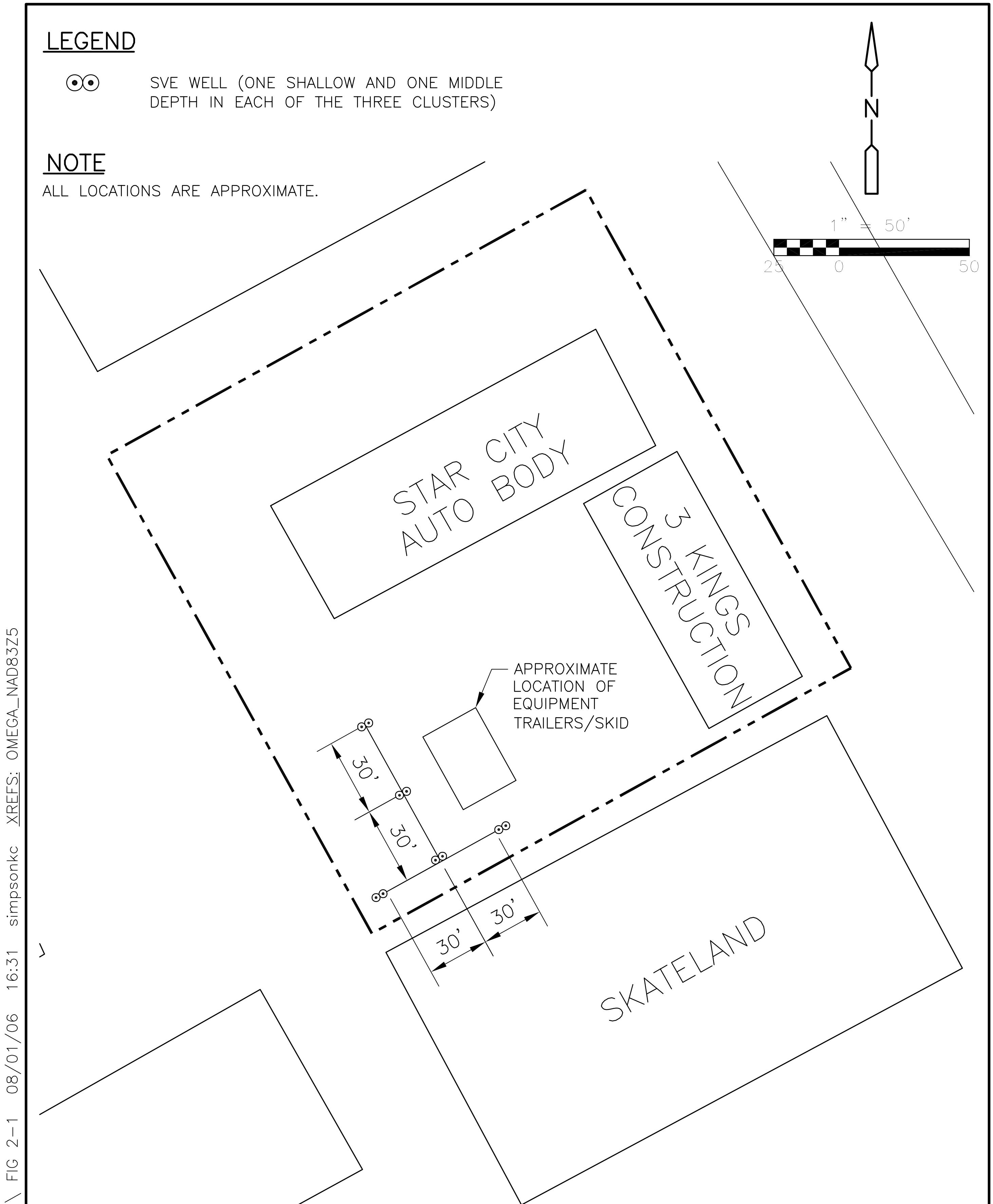
Prior to beginning the SVE testing, pre-test subsurface pressure readings and photoionization detector/flame ionization detector (PID/FID) measurements will be taken at all SVE/monitoring wells.

2.2.2 Test Measurements

A step test will be performed at each of the ten SVE wells. Step testing will begin with dilution air feed only (no vacuum applied to the wells and atmospheric air pulled through the pump). The first step will correspond to an applied vacuum of approximately 12 inches of mercury at the wellhead, with subsequent steps at approximately 15 and 18 inches of mercury per well. These vacuum levels may be modified based on the achievable vacuum levels observed at the beginning of the test. Subsurface pressure will be measured at each non-operating SVE/monitoring well to estimate the zone of influence during each step. A given step will continue until pressure readings in the monitoring wells have stabilized to a degree that is reasonable given the duration of each step test (anticipated to be 1 day). The extracted vapors will be monitored with a field PID/FID during the step tests to estimate the total VOC removal rate over time.

During a minimum of two of the step tests, transient vacuum readings will be taken to allow for calculation of intrinsic permeability of the soils. The treatment zone will initially be defined as that volume of soil surrounding the SVE well where at least 0.05 inch of water vacuum is established. During design, this definition may be refined based on the test results.

The remainder of the test will consist of operating the vacuum pump at a vacuum that targets the selected flow rate from the step testing results. This flow rate will be selected such that the treatment zone size is maximized and the associated applied vacuum could practically be provided on a full-scale system (i.e., this will not necessarily just be the maximum vacuum that the pilot pump can produce, as the pump performance curve and step test results will be considered together). This portion of the test is intended to define the VOC mass removal time trend in extracted vapor and defining the vacuum distribution in the surface as it reaches equilibrium. In addition to continued monitoring of the extracted vapors with the field PID/FID, samples of the extracted vapors and the treated vapors will be collected in Summa canisters for offsite laboratory analysis of VOCs (see Section 3.2.1). It is anticipated that the extended testing period will also include multiple well operation. In addition, additional wells may be installed and tested during this portion of the test (see Section 5.5).



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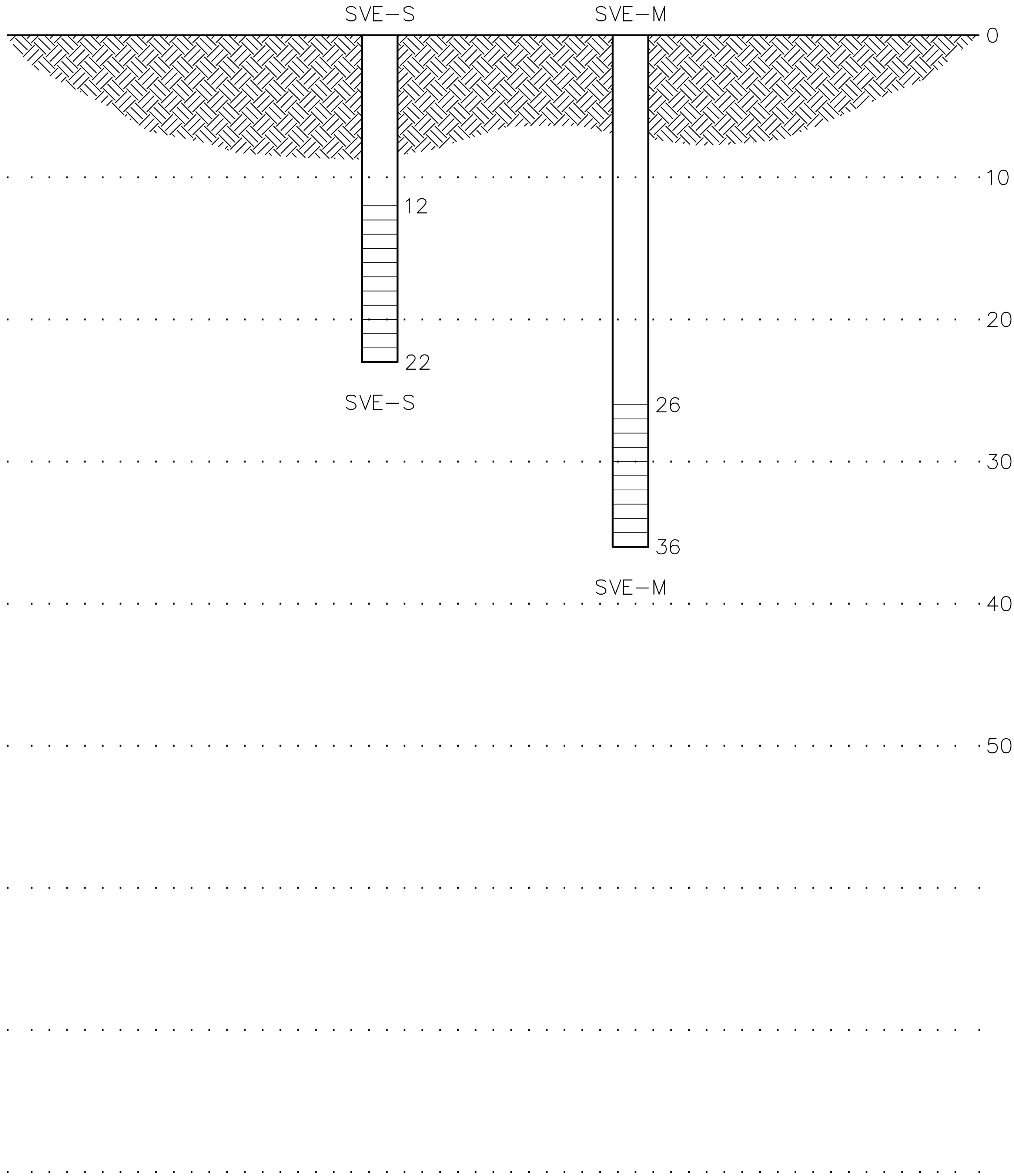
Proposed Layout of Pilot Test SVE / Monitoring Wells

CDM

Figure 2-1



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Proposed Screened Intervals for SVE / Monitoring Wells

CDM

Figure 2-2

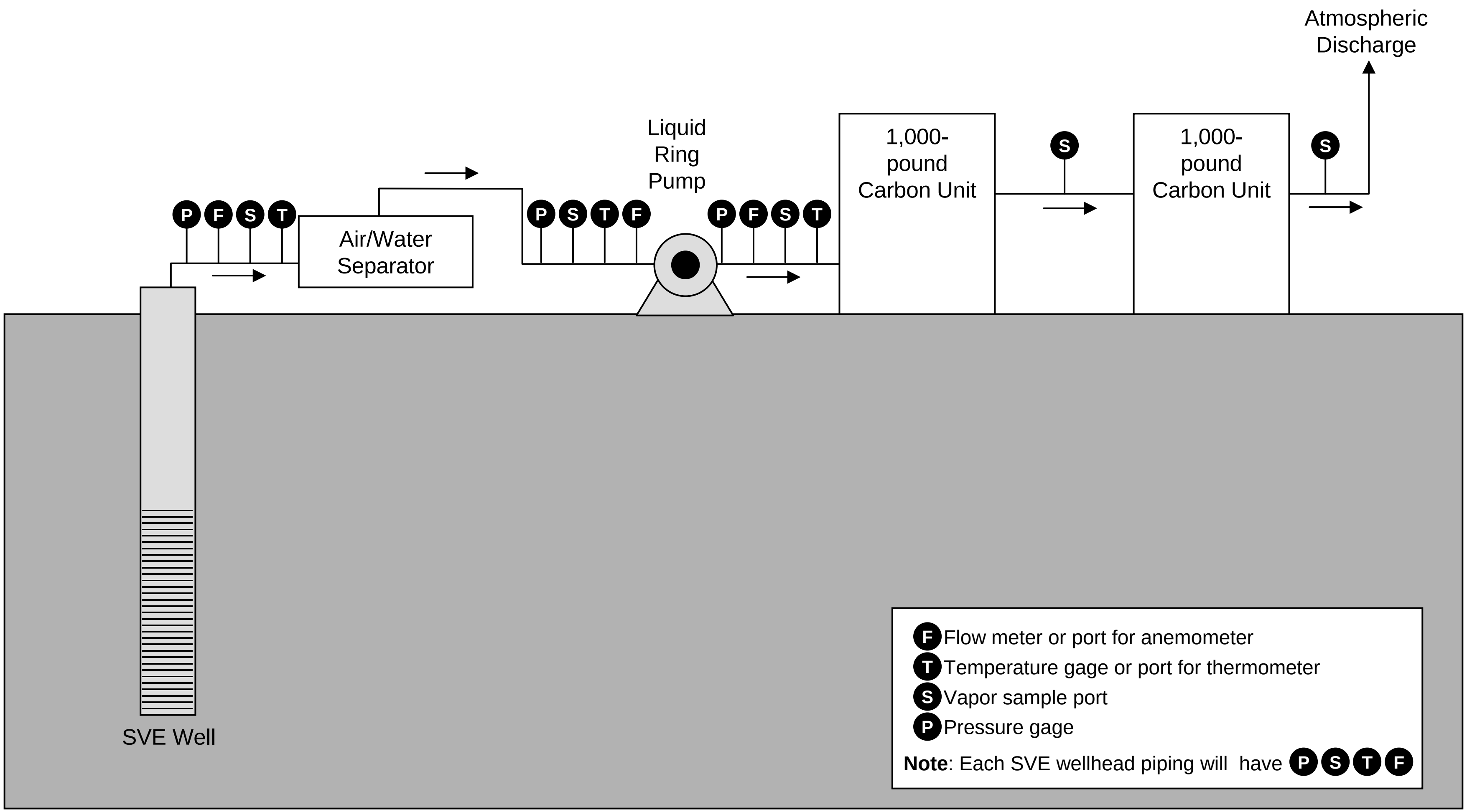

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Figure 2-3
Schematic of SVE Pilot System

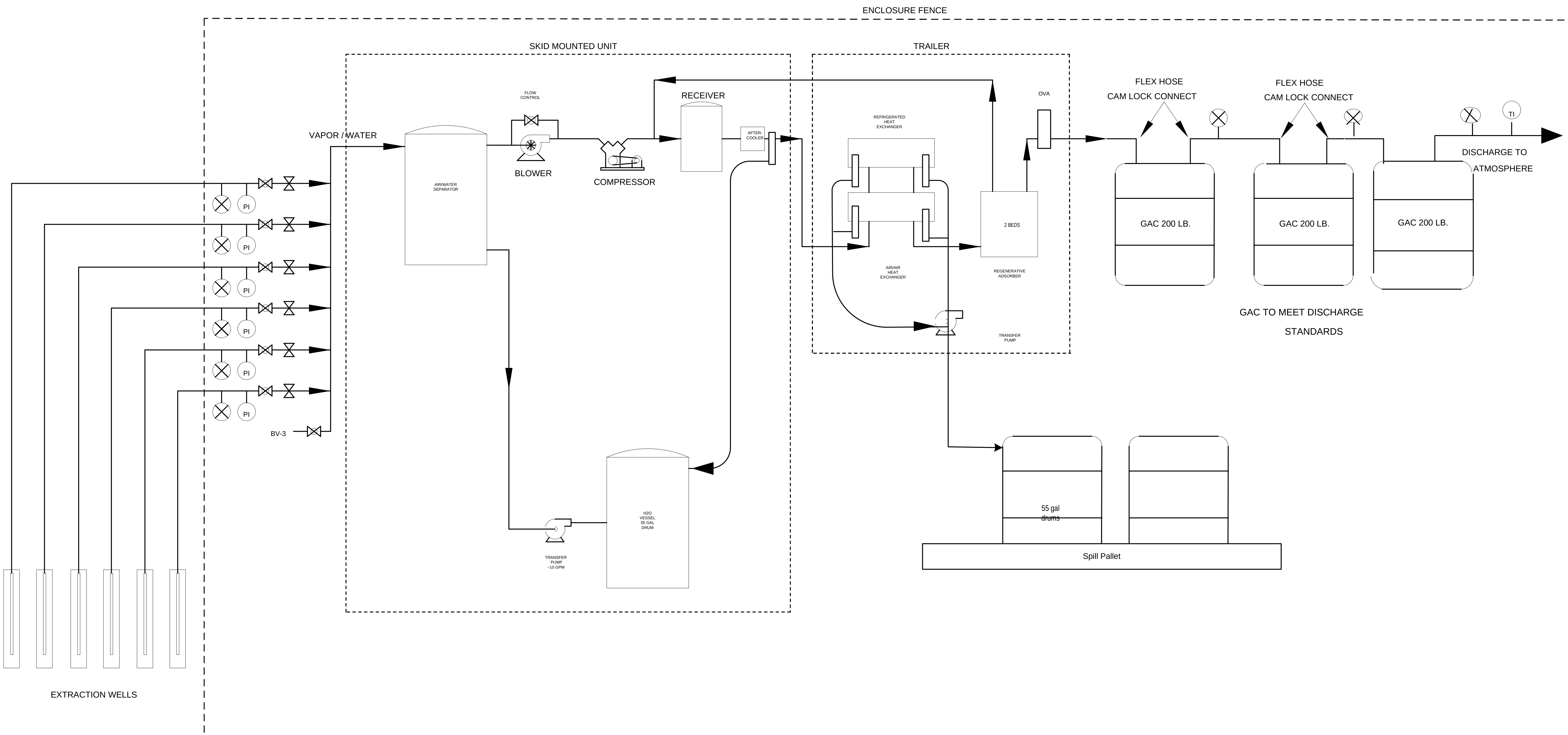

Figure 2.4 Vapor Treatment Schematic

Section 3
Sampling and Analysis Plan

This section describes the data quality objectives (DQOs), monitoring equipment, and monitoring methods that will be used during the pilot testing.

3.1 Data Quality Objectives

Data quality objectives are qualitative and quantitative statements that specify the quality of the data required to support decisions made during testing activities. DQOs are based on the end uses of the data to be collected.

Field and analytical data can be used for a vast number of purposes ranging from qualitative field screening data to quantifiable enforcement level data. The EPA has developed two descriptive data categories to assist in the interpretation of data: 1) screening data with definitive confirmation, and 2) definitive data. Screening data are generated by rapid, less precise analytical or sample preparation methods and provide analyte identification and quantification; however, quantification may be somewhat approximate. Definitive data, on the other hand, are generated using rigorous analytical methods, generally EPA-approved reference methods, with confirmation of analyte identity and concentration. Definitive data generate tangible raw data and require additional QA/QC elements, including, but not limited to, QC blanks, matrix spike samples, and performance evaluation (PE) samples.

For pilot tests, the test objectives are typically achieved through the collection and use of screening level data, with a limited amount of definitive data also collected for confirmation.

- The screening data are used to rapidly identify and quantify site conditions and test performance, although the quantification can be relatively imprecise.

- The definitive confirmation data allow for more precise interpretation of screening data.

This approach is supported by the end use of the data, mainly to assess technical feasibility and to ultimately support remedial design. For example, SVE off-gas treatment systems can address a broad range of contaminants and concentrations. Therefore, it is necessary that the SVE test data provide information regarding contaminant types and concentration ranges to be treated.

Considering the above, the objectives of this SVE testing will be achieved through the collection and use of screening data, with some additional data collected for confirmation. Specifically, samples of extracted vapor will be collected and sent for off site laboratory analysis as described in Section 3.2.1 below. Quality Assurance and Quality Control (QA/QC) is discussed in Section 3.3.

The DQO process is a series of planning steps that are designed to ensure that the type, quantity, and quality of environmental data used in decision-making are appropriate for the intended purpose. The EPA has issued guidelines to help data users develop site-specific DQOs (USEPA 2000). The DQO process is intended to:

- Clarify the study objective
- Define the most appropriate type of data to collect
- Determine the most appropriate conditions from which to collect the data
- Specify acceptable levels of decision errors that will be used as the basis for establishing the quantity and quality of data needed to support the design

The DQO process specifies project decisions, the data quality required to support those decisions, specific data types needed, data collection requirements, and analytical techniques necessary to generate the specified data quality. The process also ensures that the resources required to generate the data are justified. The DQO process consists of seven steps of which the output from each step influences the choices that will be made later in the process. These steps are as follows:

- Step 1: state the problem
- Step 2: identify the decision
- Step 3: identify the inputs to the decision
- Step 4: define the study boundaries
- Step 5: develop a decision rule
- Step 6: specify tolerable limits on decision errors
- Step 7: optimize the design

During the first six steps of the process, the planning team develops decision performance criteria (that is, DQOs) that will be used to develop the data collection design. The final step of the process involves designing the data collection program based on the DQOs. A brief discussion of these steps and their application to this work plan is provided below.

3.1.1 Step 1: State the Problem

The purpose of this step is to describe the problem to be studied so that the focus of the study will be unambiguous. To summarize the problem, former solvent recycling activities have resulted in the release of chemicals to groundwater and soils of the Site. Elevated concentrations of Freons, PCE, TCE, and other chlorinated products have been detected in soils and groundwater. These chemicals could potentially have an adverse effect upon human health and the environment.

3.1.2 Step 2: Identify the Decision

This step identifies the questions that the investigation will attempt to resolve, and actions that may take place based on investigation results. The specific objectives of the pilot testing are stated in Section 1.5. The goal of this work plan is to provide the methods and guidance to develop the data necessary to support these objectives.

The following are principal questions addressed by the activities described in this work plan:

- Is SVE a feasible technology for the site?
- If feasible, what are the design parameters for a full-scale SVE system?

Actions that could result from resolution of these questions:

- Design and installation of a SVE system at the site (following preparation of the FS)

The decision statement for this investigation is to generate data sufficient to support the FS regarding SVE.

3.1.3 Step 3: Identify the Inputs to the Decision

The purpose of this step is to identify the information and measurements needed to support the decision statement. This is determined by the data uses. Data will be used to achieve the following:

- Estimate the treatment zone sizes for SVE wells screened at different depths at various levels of applied vacuum
- Estimate chemical concentrations in extracted vapors to support selection and design of an appropriate vapor treatment technology
- Determine the VOC mass removal rates via SVE at two depths
- Based on data uses and availability, the following primary data are needed:
- Soil vacuum distribution during SVE operation
- VOC concentrations in extracted vapors from SVE wells screened at different depths
- Relationship between applied vacuum and extraction rate

3.1.4 Step 4: Define the Boundaries of the Study

This step defines the time periods and spatial area to which decisions will apply and determines when and where data should be collected. Information describing the spatial boundaries of the site is provided in Section 1.2. Section 3.0 describes sampling locations and the schedule of investigation events is discussed in Section 5.5.

3.1.5 Step 5: Develop a Decision Rule

The purpose of this step is to define the parameters of interest, specify the action level, and integrate previous DQO outputs into a single statement that describes a logical basis for choosing among alternative actions.

As described in previous sections, the purpose of this investigation is to provide data for use in the FS. Parameters of interest are: contaminant concentrations in extracted soil gas and treated vapors, and subsurface vacuum readings.

The following decisions will be based on the data:

If SVE is feasible given site conditions, then determination will be made as to whether the data collected in this investigation are sufficient to support the FS and design phase, if appropriate.

3.1.6 Step 6: Specify Tolerable Limits on Decision Errors

Tolerable limits on decision errors, which are used to establish performance goals for the data collection design, are specified in this step.

Section 3.2 discusses the monitoring/sampling design basis and rationale and the quantity of samples to be collected. The quality of data necessary for the purposes of the investigation is also described in the sections below.

3.1.7 Step 7: Optimize the Design for Obtaining Data

The work plan was optimized to focus on collection of data based on data uses, availability of historical data, and identified data gaps. The data collection program, including sampling rationale, is presented in the sections that follow.

3.2 Field Equipment and Sampling/Monitoring Procedures

This section describes the field equipment and instrumentation that will be used for monitoring during the testing.

3.2.1 Vapor Sampling

Vapor sampling will consist of on and offsite vapor analysis coupled with the collection of extraction flow rate measurements. For GAC treatment, samples of extracted vapors will be collected for VOC analysis from a sample port on the SVE effluent and from sample ports in between the GAC units and at the effluent of the second GAC unit and from SVE/monitoring wells. For condensation treatment, samples will be collected from the SVE blower effluent, the condenser effluent, and between ant he effluent of the GAC polishing units. Samples will be analyzed for VOCs on site with a field PID/FID and selected samples will be sent off site in summa canisters for laboratory analysis. Samples from a wide range of PID/FID readings will be chosen for laboratory analysis so that relationships can be developed between total VOCs detected in the laboratory and the PID and FID readings.

Onsite Vapor Quality Measurement

A field PID/FID will be used to frequently measure the total VOC concentration in the vapor samples. The PID/FID will be used to "sniff" the extracted vapor concentration at the SVE sample port, or the vapors within the wells during SVE operation. Sampling frequency for the PID/FID is given in Table 3-1.

Offsite Vapor Quality Measurement

To gather definitive data on the VOC concentrations in extracted vapors, samples will be collected from the SVE and vapor treatment vapor sample ports in Summa canisters (volume one liter or less) for off Site analysis at Air Toxics (Folsom, CA) according to EPA methods TO-15 for VOCs. Vapor sampling frequency for off site analysis is given in Table 3 1.

Vapor Flow/Vacuum Measurement

The total vapor extraction rate from the SVE unit will be monitored by a direct-read, in-line flow meter (approximately 0 to 125 scfm, $\pm$ 2 percent). In addition, flow from each SVE well will be measured within the piping coming from each well. It is anticipated that these measurements will be made with a hand held anemometer or pitot tube/magnehelic gage. The extraction vacuum will be measured at the SVE wellhead using a vacuum gage (0 to 30 inches of mercury, $\pm$ 1 percent). All vacuum gages will be synchronized to a common zero reading prior to use. The flow rate and wellhead vacuum measurement frequencies are given in Table 3-1.

3.2.2 Subsurface Static Pressure Measurement

During the multi-week test, subsurface static pressure readings will be taken from the SVE/monitoring wells using a magnehelic gage. Each well will be fitted with an airtight fitting that allows for the attachment of the magnehelic gage without loss of vacuum within the point. The frequency for measuring subsurface static pressure is given in Table 3-1. During at least one test, transient pressure data will be collected at an appropriate well to provide additional data to calculate the average intrinsic permeability of the Site soils.

3.2.3 Barometric Pressure Measurement

Barometric pressure fluctuations can affect the subsurface static pressure during testing. A barometer ($\pm$ 0.03 inch of mercury) will be on site for monitoring this parameter throughout the testing. The frequency for measuring barometric pressure is given in Table 3-1.

3.3 QA/QC Requirements

This section describes the QA/QC methods that will be used to perform the SVE testing. Additional discussion of QA/QC procedures is provided in Section 7 of the OSS RI/FS Work Plan.

3.3.1 Sampling

Duplicate Samples – Co-located samples will be collected for vapor samples at a minimum frequency of 10 percent.

Trip/Equipment Blanks – A trip/equipment blank will be sent with each shipment of vapor samples (including indoor air samples) sent to the off site laboratory.

3.3.2 Field Instrument Calibration

Field equipment will be calibrated in accordance with the manufacture's instructions. Instruments requiring field calibration will be checked and adjusted before and after each day of use. Calibration results will be recorded in the field and the calibration logs will be included in reporting pilot results.

Table 3-1
Sampling and Monitoring Schedule

Test Phase	Parameter	Location	#/Location	Instrument
Pre-Test	Subsurface Vacuum	All SVE Wells	1	Magnehelic Gage
	Barometric Pressure	Air	1	Barometer
	Vapor VOCs	All SVE Wells	1	Field PID/FID
Pilot Test				
Step Test	Vapor and Dilution Air Flow Rate	SVE Effluent	At least 5/step	Flow Gage
	Wellhead Vacuum	Operating SVE Wellhead	At least 5/step	Vacuum Gage
	Subsurface Vacuum	All Non-Operating Wells	At least 5/step (for transient data, every 15 minutes during the first step)	Magnehelic Gage
	Vapor VOCs	Extracted Vapors	At least 5/step	Field PID/FID
	Vapor VOCs	Extracted Vapors	1 at the end of each step test	Off Site Lab
	Vapor VOCs	Vapor Treatment Effluent	1/day	Off Site Lab
	Barometric Pressure	Air	At least 3/day	Barometer
Multi-Week Test				
	Vapor and Dilution Air Flow Rate	SVE Effluent and Each Operating Well	1/day	Flow Gage
	Wellhead Vacuum	Operating SVE Wellhead	1/day	Magnehelic Gage
	Subsurface Vacuum	All Non-Operating Wells	1/day	Magnehelic Gage
	Vapor VOCs	All Non-Operating Wells	1/week	Field PID/FID
	Vapor VOCs	Extracted Vapors	1/day	Field PID/FID
	Vapor VOCs	Extracted Vapors	1/week	Off Site Lab
	Vapor VOCs	Vapor Treatment Effluent	1/week	Off Site Lab
	Barometric Pressure	Air	2/day	Barometer

Section 4
Analysis and Interpretation of Test Results

This section describes the data analysis, interpretation, and reporting methods that will be used in evaluating the SVE test results. The data and measurements collected during the SVE testing will provide the following information relevant to SVE performance and remedial design:

- VOC mass removal rate via vapor extraction from two depth intervals
- Zone of influence of the SVE wells in two depth intervals
- Airflow rates that can be achieved at various applied vacuum levels
- Type and concentration of VOCs in extracted vapors and in vapor treatment effluent samples to support treatment system selection to meet South Coast Air Quality Management District (SCAQMD) emission requirements for site contaminants

4.1 Data Analysis and Interpretation

Data collected from the SVE testing will be evaluated to support the objectives of the test, including:

- Atmospheric discharge limitations
- Subsurface pressure data will be used to estimate the SVE zone of influence at various levels of applied vacuum
- Vapor extraction rates and wellhead vacuum levels will be used to size SVE pumps for the full-scale system
- Vapor VOC data will be used to evaluate and size vapor treatment systems
- Site construction limitations

4.2 Reporting

CDM will prepare and submit a SVE Pilot Test Technical Memorandum (TM) approximately 4 weeks after completion of the testing to allow availability of all analytical results for inclusion in the TM. The TM will contain a summary of the methods used in the testing and any deviations from this work plan that occurred during the testing. It will present the results, an interpretation of the results with regard to SVE design, as well as laboratory reports and relevant maps, tables and figures.

Section 5
Additional Issues

5.1 Health and Safety

Health and safety procedures will conform to the existing Site Health and Safety Plan for the site. It is anticipated that the pilot testing can be completed using Level D personal protection.

5.2 Permitting

The pilot testing will be performed under substantive compliance with SCAQMD permit requirements for SVE operating with GAC vapor treatment. For operations with the condenser vapor treatment, the equipment supplier's (GEO Inc.) multi-site air discharge permit issued by SCAQMD (Appendix A) will be used. These are the only anticipated permits needed to perform the testing.

5.3 Residuals Management

The anticipated residuals from this testing include drill cuttings from well installation, spent GAC and condensed liquids from the vapor treatment unit. Drill cuttings will be drummed and temporarily stored on-site, and labeled as investigation-derived waste pending receipt of the pre-disposal sample results. If cuttings are determined to be hazardous, they will be transported (accompanied by hazardous waste manifests) to an approved facility for disposal. If determined to be non-hazardous, cuttings will be transported to an approved disposal facility, such as a Class III landfill for soils. Spent GAC will be regenerated or disposed of off-site by the vendor. Condensed liquids will be recycled or disposed of off-site.

5.4 Staffing

CDM staff will direct the pilot testing with a subcontractor providing equipment and an operator for test startup. Sharon Wallin of CDM's Irvine office will be project manager and Dave Chamberlin of CDM's Denver office will be the client officer. John Eisenbeis of CDM Denver will serve as technical director for all work discussed herein, and will be the lead author for the pilot test TM.

5.5 Schedule

The schedule for implementation of the SVE testing is contingent upon obtaining access from the property owner and tenant at 3 Kings Constructions, scheduling drillers and equipment suppliers, and obtaining EPA approval of this work plan. It is anticipated that the wells will be installed approximately one week following EPA approval of this work plan and upon gaining all appropriate access. Testing will likely then begin the following week, assuming all equipment is available. It is anticipated that the initial testing will be performed over a period of 3 weeks. The anticipated sequence and duration of tests follows:

- Setup/shakedown (1 day)
- Step testing of all five shallow SVE wells (5 days)
- Step testing of all five 30 foot sand SVE wells (5 days)
- Testing of shallow and 30 foot sand SVE wells together (4 days)

Following this initial testing, the SVE wells will be operated in various combinations (two adjacent wells at the same depth, and two adjacent wells at different depths) for several weeks to gather data regarding longer term mass removal rates. Two of these additional weeks will be used to test the condensation technology for vapor treatment. In addition, the multi-week testing may include SVE operations at additional locations onsite. Depending on the results of the first two weeks of testing, OPOG may propose to install additional SVE/monitoring wells like the ones described in this work plan in other portions of the Site. With EPA approval, the multi-week testing would then be extended to operate these other wells with the intent of determining whether there are significant differences in extracted vapor composition and/or concentration, and whether there are significant differences in the achievable ROI in the two depths of the subsurface tested.

Figure 5-1 presents a preliminary schedule for tasks associated with the testing.

Figure 5-1. Pilot Test Schedule

	Week After Work Plan Approval															
Task	1	2	3	4	5	6	7	8	9	10	11	12	13	15	16	17
Procure Equipment																
Install Wells																
Initial Testing																
Extended System Operation/Demob																
Prepare Draft TM																
EPA Review of TM																
Prepare Final TM																

Section 6
References

CDM 2003. *Report Addendum for Additional Data Collection in the Phase 1a Area*. June 27.

CDM 2003. *On-Site Soils Remedial Investigation/Feasibility Study Work Plan*. September 29.

CDM 2004. *On-Site Soils Work Plan Addendum, Scope of Work for Additional Investigation*. October 20.

Appendix A

VAPOR RECOVERY SYSTEM AND PERMIT

A pre-permitted 100 scfm compression-condensation SVE recovery system (G.E.O. WS-100) will be used for the extended SVE pilot test / remediation. The compression-condensation system uses a skid mounted blower/compressor assembly to extract and compress the soil vapor to approximately 150 psi. Prior to entering the blower/compressor assembly, the influent vapor is routed through a water knock-out drum, where entrained water is captured. The compressed vapors are stored in a receiver vessel, then cooled to near ambient temperatures with an aftercooler. The compressed vapor is routed from the aftercooler through a series of air/air heat exchangers and refrigerated heat exchangers which sequentially chill the vapor to an approximate temperature of -45 degrees F. Water vapor and VOCs are condensed and collected in stainless steel condensate drains at this stage. Two types of fluid wastes are produced by the compression-condensation system: 1) an aqueous waste that, based on profile analyses, contains low concentrations of dissolved VOCs in water, and 2) a free-phase solvent liquid that may be eligible for recycling/reuse. The fluid wastes are collected in DOT-specification 55-gallon drums staged on top of spill-containment palettes.

Following the refrigeration stage of the treatment process, the remaining vapors are routed through a proprietary regenerative adsorber, followed by carbon polishing. The system effluent is monitored by organic vapor sensors that are connected to the main system controls. The sensors automatically shut the system off in the event that effluent concentrations exceed the South Coast Air Quality Management District (SCAQMD) permit limits. The operation of the aforementioned compression-condensation recovery equipment is permitted under a SCAQMD Various Locations permit.

Electrical service to the compression-condensation system consists of 3-phase 480 volt and single phase 220 volt service. A licensed electrician will establish a connection to the facility's main electrical panel, and install the necessary transformer if required, circuit breakers, and outlets.

PERMIT TO OPERATE

This initial permit must be renewed ANNUALLY unless the equipment is moved, or changes ownership. If the billing for annual renewal fee (Rule 301.f) is not received by the expiration date, contact the District.

Legal Owner or Operator: G.E.O. INC
1605 W SUMAC LN
ANAHEIM, CA 92802

ID 109002

Equipment Location: VARIOUS LOCATIONS IN SCAQMD

Equipment Description:

SOIL-VAPOR-EXTRACTION AND TREATMENT SYSTEM CONSISTING OF:

1. EXTRACTION WELL.
2. WATER KNOCKOUT TRAP, 55 GALLONS
3. EXTRACTION BLOWER, 25 H.P., MAXIMUM FLOW RATE 200 CFM.
4. VAPOR RECOVERY SYSTEM CONSISTING OF:

   A. RECEIVER, 80 GALLON CAPACITY
   B. AFTERCOOLER, 130,000 BTU PER HOUR
   C. TUBE IN SHELL (AIR/AIR) HEAT EXCHANGER
   D. TUBE IN SHELL (REFRIGERATED) HEATED EXCHANGERS.
   E. REFRIGERATED CONDENSER, TECUMSEH, MODEL NO. CL13A692CA, 6900 BTU PER HOUR.
   F. COALESCING FILTER, HANKISON, MODEL NO. A100-0BF-48
   G. REGENERATIVE ADSORBER

5. CARBON ADSORBER, CARBTROL, MODEL G1-200, WITH 200 POUNDS OF ACTIVATED CARBON.

Conditions:

1. OPERATION OF THIS EQUIPMENT SHALL BE CONDUCTED IN ACCORDANCE WITH ALL DATA AND SPECIFICATIONS SUBMITTED WITH THE APPLICATION UNDER WHICH THIS PERMIT IS ISSUED UNLESS OTHERWISE NOTED BELOW.

2. THIS EQUIPMENT SHALL BE PROPERLY MAINTAINED AND KEPT IN GOOD OPERATING CONDITION AT ALL TIMES.

3. THE EXTRACTION BLOWER SHALL ONLY BE OPERATED WHEN ALL THE EXTRACTED VAPORS ARE VENTED BY THE VAPOR RECOVERY UNIT AND THE CARBON ADSORBER, AND

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WHEN THERE ARE NO DETECTABLE LEAKS BETWEEN THE OUTLET OF THE BLOWER AND THE OUTLET OF THE VAPOR CONTROL SYSTEM.

4. AN IDENTIFICATION TAG OR NAME PLATE SHALL BE DISPLAYED ON THE EQUIPMENT TO SHOW MANUFACTURER MODEL NO. AND SERIAL NO. THE TAG(S) OR PLATE(S) SHALL BE ISSUED BY THE MANUFACTURER AND SHALL BE ADHERED TO THE EQUIPMENT IN A PERMANENT AND CONSPICUOUS POSITION.

5. CURRENT CONTACT PERSON NAME, COMPANY AND PHONE NUMBER SHALL BE DISPLAYED IN A PERMANENT AND CONSPICUOUS POSITION.

6. THE SCAQMD SHALL BE NOTIFIED IN WRITING OF THE FOLLOWING INFORMATION AT LEAST FIVE DAYS PRIOR TO OPERATING OF THE EQUIPMENT AT THE NEW LOCATION:

   A. THE LOCATION WHERE THE EQUIPMENT WILL BE OPERATED.
   B. THE ESTIMATED CALENDAR TIME THE EQUIPMENT WILL BE OPERATED AT THE LOCATION, AND
   C. ALL OPERATING RECORDS REQUIRED AT THE PREVIOUS LOCATION.

   NOTIFICATION SHALL BE ADDRESSED TO:

   SCAQMD
   RULE 1166 COMPLIANCE SECTION,
   STATIONARY SOURCE COMPLIANCE
   21865 E. COPLEY DR.
   DIAMOND BAR, CA. 91765-4182

7. THIS EQUIPMENT SHALL NOT BE OPERATED MORE THAN 12 MONTHS AT ANY ONE LOCATION IN THE DISTRICT.

8. A COPY OF THIS PERMIT SHALL BE PRESENT AT THE SITE.

9. A FLOW INDICATOR SHALL BE INSTALLED AND MAINTAINED AT ALL INLET STREAMS TO THE VAPOR CONTROL SYSTEM TO INDICATE THE TOTAL AIR FLOW RATE IN CUBIC FEET PER MINUTE (CFM). THE TOTAL FLOW RATE SHALL NOT EXCEED 200 CFM. IN CASE A PRESSURE SENSOR DEVICE IS USED IN PLACE OF THE FLOW INDICATOR, A CONVERSION CHART SHALL BE POSTED ON THE EQUIPMENT TO INDICATE THE CORRESPONDENT FLOW RATE, IN CFM, TO THE PRESSURE READING.

10. THIS EQUIPMENT SHALL ONLY BE USED TO EXTRACT AND TREAT VAPORS FROM SOILS CONTAMINATED WITH CHLORINATED SOLVENTS (AND THEIR BY-PRODUCTS) AND BTEX's COMPOUNDS.

11. VOLATILE ORGANIC COMPOUND (VOC) CONCENTRATION SHALL BE MEASURED AT THE INLET AND OUTLET OF THE CARBON ADSORBER AND THE INLET TO THE VAPOR RECOVERY SYSTEM AT LEAST ONCE EVERY OPERATING DAY FOR THE FIRST 7 DAYS OF OPERATION, THEN ONCE EVERY 7 DAYS OF OPERATIONS THEREAFTER, BY USING A FLAME IONIZATION DETECTOR OR A DISTRICT APPROVED ORGANIC VAPOR ANALYZER (OVA)

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CALIBRATED IN PARTS PER MILLION BY VOLUME (PPMV) OF METHANE ADJUSTED TO PERCHLOROETHYLENE OR TRICHLOROETHYLENE.

12. VOLATILE ORGANIC COMPOUND (VOC) CONCENTRATION SHALL BE MONITORED AT THE OUTLET OF THE REGENERATIVE ADSORBER CONTINUOUSLY, BY USING A FLAME IONIZATION DETECTOR OR A DISTRICT APPROVED ORGANIC VAPOR ANALYZER CALIBRATED IN PARTS PER MILLION BY VOLUME (PPMV) OF METHANE ADJUSTED TO PERCHLOROETHYLENE OR TRICHLOROETHYLENE.

13. THE VOC INLET CONCENTRATION TO THE VAPOR RECOVERY SYSTEM SHALL NOT EXCEED 30000 PPMV.

14. THE VOC OUTLET CONCENTRATION OF THE REGENERATIVE ADSORBER SHALL NOT EXCEED 100 PPMV.

15. THE VOC OUTLET CONCENTRATION FROM THE CARBON ADSORBER SHALL NOT EXCEED 2 PPMV.

16. EQUIPMENT SHUTDOWN INTERLOCKS SHALL BE PROVIDED FOR WHEN THE VOC CONCENTRATION EXCEEDS THE LEVEL STATED IN CONDITION NO. 14.

17. THE CARBON ADSORBER SHALL BE REPLACED WITH FRESH ADSORBENT WHEN THE VOC CONCENTRATION MEASURED AT THE OUTLET OF THE CARBON ADSORBER EXCEEDS THE VALUE LISTED IN CONDITION NO. 15.

18. THE ACTIVATED CARBON USED IN THE PRIMARY AND SECONDARY ADSORBER SHALL HAVE A CTC NO. NOT LESS THAN 60% AS MEASURED BY ASTM METHOD D3467.

19. RECORDS SHALL BE MAINTAINED TO PROVE COMPLIANCE WITH CONDITIONS NO. 7, 10, 11, 12, 13, 14, 15 AND 17. THE RECORDS SHALL BE KEPT FOR AT LEAST TWO YEARS AND MADE AVAILABLE TO DISTRICT PERSONNEL UPON REQUEST.

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PERMIT TO OPERATE

CONTINUATION OF PERMIT TO OPERATE

NOTICE

IN ACCORDANCE WITH RULE 206, THIS PERMIT TO OPERATE OR A COPY SHALL BE POSTED ON OR WITHIN 8 METERS OF THE EQUIPMENT.

THIS PERMIT DOES NOT AUTHORIZE THE EMISSION OF AIR CONTAMINANTS IN EXCESS OF THOSE ALLOWED BY DIVISION 26 OF THE HEALTH AND SAFETY CODE OF THE STATE OF CALIFORNIA OR THE RULES OF THE AIR QUALITY MANAGEMENT DISTRICT. THIS PERMIT CANNOT BE CONSIDERED AS PERMISSION TO VIOLATE EXISTING LAWS, ORDINANCES, REGULATIONS OR STATUTES OF OTHER GOVERNMENT AGENCIES.

EXECUTIVE OFFICER

Dorris M. Bailey

By Dorris M. Bailey/rdo
8/23/1996

ORIGINAL

Omega Chemical Site

Soil Vapor Extraction Pilot Test Work Plan

August 4, 2006

Prepared for:

Omega Chemical Site PRP Organized Group

Prepared by:

CDM
18581 Teller Avenue, Suite 200
Irvine, California 92612

Project No. 10500-37240-T2.OSS.SVEPILOT

Contents

Deleted: 3
Deleted: 4
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Deleted: 7
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Deleted: 8
Deleted: 8
Deleted: 8
Deleted: 8
Deleted: 9
Deleted: 3

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List of Figures

List of Tables

Appendices

Section 1
Introduction

1.1 Scope of Work

Camp Dresser & McKee Inc. (CDM) has prepared this work plan on behalf of the Omega Chemical Site Potentially Responsible Party (PRP) Organized Group (OPOG) to pilot test soil vapor extraction (SVE) at the Omega Chemical Site (Site). This document has been prepared in accordance with the Statement of Work in Consent Decree (CD) No. 00-12471 between the United States Environmental Protection Agency (EPA) and OPOG. The CD was lodged on November 24, 2000 and entered into the US District Court on February 28, 2001.

The pilot test is being conducted to collect data confirm the feasibility of SVE and to assist in the design and implementation of a potential full-scale SVE system at the Site, if appropriate. The primary VOCs at the Site and adjacent parcels are tetrachloroethene (PCE), trichloroethene (TCE), 1,1-dichloroethene (1,1-DCE), Freon 113, and Freon 11.

This work plan describes the pilot testing that will be performed to provide a basis for design for a potential full-scale SVE on the Omega site. This document supersedes the draft work plan submitted to the EPA on November 30, 2004 and the revision dated December 28, 2004, and incorporates responses to EPA comments on previous drafts, as appropriate.

1.2 Site Introduction and Background

This section provides a brief summary of applicable site conditions. A more complete description can be found in the *On-Site Soils (OSS) Remedial Investigation/Feasibility Study (RI/FS) Work Plan* (CDM September 29, 2003).

The Site is located at 12504/12512 East Whittier Boulevard in Whittier, California. The site was developed in 1951 and occupies Los Angeles County Assessor Tract No. 13486, Lots 3 and 4. The Site is approximately 41,000 square feet in area (200 feet wide by 205 feet long) and contains two structures – an approximate 140-foot by 50-foot warehouse and an approximate 80-foot by 30-foot administrative building. A loading dock is also attached to the rear of the warehouse. The exterior areas are concrete-paved and the site is secured with a perimeter fence and locking gate. The Site is currently occupied by two tenants – Star City Auto Body located in the northern portion (consisting of warehouse and exterior parking lot) and 3 Kings Construction in the southern portion (consisting of small office building and exterior parking lot).

Adjacent and Nearby Properties

One commercial property (Skateland) and two industrial properties (Medlin & Son and Terra Pave) are located immediately adjacent to the Site (southeastern, northwestern, and southwestern boundaries, respectively). The three commercial/

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industrial properties immediately adjacent to the Site and other nearby properties are discussed below.

Skateland is located on Whittier Boulevard, adjacent to the southeastern boundary of the Site. The property consists of an indoor roller-skating rink that is currently in operation and is open to the general public.

The Terra Pave, Inc. facility is located at 12511 East Putnam Street, adjacent to the southwestern boundary of the Site. New England Lead Burning Company (NELCO) reportedly operated the property beginning in the mid-1950s. NELCO purchased lead in sheet, pipe and solid rods and fabricated the desired product by burning (welding) the lead to the required shape. The welding was performed in the building located along the northeastern portion of the property. Undeveloped portions of the property consisted of exposed soil and miscellaneous rubble.

The Medlin & Son (formerly, Cal-Air) facility is located at 12484 Whittier Boulevard, adjacent to the northwestern boundary of the site. A machine shop and office were reportedly constructed at the property in 1954. In September 1976, Cal-Air Conditioning Company added three new offices and occupied the property until 1996. Medlin & Son currently operate a machine shop at the property, producing specialty small metal parts.

Local Hydrogeology

The site is underlain by low permeability silty and clayey soils of the upper Pleistocene Lakewood Formation, probably representing the Bellflower aquiclude, to a depth of at least 120 feet bgs. The term "aquiclude" is used in the published literature, but "aquitard" is a more accurate description of this stratigraphic unit. Soils underlying the site consist primarily of fine-grained materials (e.g., clayey silts and silty clays).

Depth-to-water in on-Site well OW-1 was measured at 75.33 feet below ground surface (bgs) during the most recent semi-annual sampling event in February 2006. A coarser-grained sandy layer, probably representing the Gage aquifer, was encountered southwest of the facility along and downgradient of Putnam Street, but was not detected beneath the Site. Observations made during sampling events performed from 1999 to the present indicate a consistent direction of groundwater flow to the southwest.

Well OW-1b (screened from 110 to 120 feet bgs), located at the adjacent Terra Pave property, was designed as a deeper companion well to on-Site well OW-1. The subsurface materials at location OW1b were very uniform and consisted of fine-grained materials (silty clays) throughout the entire drilled depth of the boring (131.5 feet bgs). Some gravel imbedded in the silty clay matrix was observed in the interval from 125 to 130 feet bgs. During the February 2006 semi-annual sampling event, depth-to-water was measured at 75.77 feet bgs in well OW-1b. Observations made during sampling events performed from 1999 to the present indicate a consistent direction of groundwater flow to the southwest.

The Report Addendum for Additional Data Collection in the Phase 1a Area (CDM, June 27, 2003) was revised to include the results of additional investigation performed by OPOG (e.g., aquifer testing, well installation, groundwater and soil sampling, etc.). The revised report includes detailed cross-sections illustrating subsurface lithology beneath and downgradient of the Site.

1.3 Soil Vapor Extraction Technology Description

SVE is an *in situ* remediation technology that removes VOCs and some semi-volatile organic compounds (SVOCs) from vadose zone and capillary fringe soils. SVE withdraws vapor from the subsurface using vacuum blowers and vapor extraction wells. The contaminated vapors are typically collected at the surface and treated and/or discharged to the atmosphere. The induced advection of air draws clean air through the contaminated vadose zone, promoting transfer of contaminants from the subsurface soil matrix to the vapor phase. In addition, SVE may stimulate aerobic biological degradation of the contaminants by increasing the oxygen content of the soil vapor.

A SVE system typically consists of a blower, a control panel, an air-water separator, a particulate filter, valving, gauges, piping, and a vapor treatment system. The type of vapor treatment system selected is based on the nature and concentrations of the contaminants.

1.4 Types of Testing

The SVE pilot testing will consist of two types of tests: step testing and a multi-week pilot test. The step testing will be performed to evaluate the relationship between applied vacuum at the SVE wells and 1) the resulting vapor flows; and 2) the resulting vacuum distributions in the subsurface around the wells. The multi-week test is intended to provide design information for potential implementation of the SVE technology once near-equilibrium conditions have been established by operating the SVE system for several weeks. Several weeks of operation are appropriate since vacuum distribution is slow to develop in low permeability soils such as those found at the Site.

1.5 Pilot Test Objectives

The overall objectives of the proposed SVE pilot test are to collect additional data which will be used in the selection, design, and implementation of the overall on-site soils remedy for the Omega site. Specifically, the collected data will aid in selecting the most appropriate SVE design parameters for a potential full-scale system at the site.

Specific objectives for this pilot test include:

- Confirm the feasibility of SVE for site conditions above the 30 foot clay unit (the 30 foot sand unit and the overlying silt).

- Confirm the ability of vapor phase granular activated carbon (GAC) and condensation technology to treat extracted vapors to appropriate discharge limits.

- Estimate the contaminant mass removal rate in extracted vapors to size and select the treatment systems for a potential full-scale system and to evaluate air discharge permit issues.

- Estimate the achievable SVE treatment zone sizes for the 30 foot sand interval and the shallower interval above this sand unit to serve as a basis to select well spacing and construction.

- Provide VOC mass removal data from SVE wells screened in two intervals to help in determining the VOC vertical distribution in the vadose zone above the 30 foot clay unit.

Section 2
Pilot Test Design and Procedures

2.1 Test Apparatus

This section describes the wells and remedial equipment that will be used to perform and monitor the pilot testing. All work will be performed in accordance with the procedures detailed in this document and in the *OSS RI/FS Work Plan* (CDM, September 29, 2003). In addition, the *OSS Work Plan Addendum, Scope of Work for Additional Investigation* (CDM, October 20, 2004) will also be followed, as appropriate.

2.1.1 SVE/Monitoring Wells

The proposed location of the testing is the lot behind the 3 Kings building. The rationale for selecting this location includes:

- High contaminant concentrations exist at all pertinent vadose sampling depths in this area
- The area is secured by fencing
- The area is big enough to accommodate all equipment and wells without significant disruption to on-going business activities

The area to the southwest of Star City Auto Body was also a candidate site for the testing based on the high soil vapor concentrations there; however, it was not selected due to security issues and to avoid disruption to the business at that building.

Ten new SVE/monitoring wells are proposed to be installed on the Site for pilot testing. Each of these wells will be capable of being used as a SVE well or as a vacuum monitoring point when other well(s) are operating. Proposed locations of the new SVE/monitoring wells are shown in Figure 2-1, although the exact locations may vary depending on site constraints and access agreements. The wells have been positioned based on previous SVE experience in similar soil conditions which indicates that the treatment zone radius in the shallow, silty soils will likely be approximately 30 feet. There are not any existing soil vapor probes in the SVE pilot test area and since the membrane interface probe (MIP)/soil vapor monitoring program is completed, it is not anticipated that additional vapor probes will be installed.

These new SVE wells will be installed using hollow stem auger drilling methods and will be constructed of 4-inch diameter PVC casing. Each borehole will be continuously sampled using a core barrel or split spoon to document the soil profile at each location. Five shallow SVE/monitoring wells will be screened from 12 to 22 feet. Five SVE/monitoring wells will target the sand layer that exists above the "30 foot clay". The total depth of these SVE/monitoring wells will be approximately 36 feet, with a screened interval over the lower 10 feet. Surfaces at each location will be completed with a flush-grade, water-tight, traffic-rated surface completion. Figure 2-2 depicts the proposed SVE screened intervals.

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The proposed SVE wells target soils above the 30 foot clay layer since these are the soils that contain contaminants that may migrate upwards and pose a risk to indoor air quality in adjacent buildings. Deeper soils are not considered to be a significant risk to indoor air quality due to the barrier to upward soil vapor transport posed by the 30 foot clay layer. The deeper soil (i.e., below the 30 foot clay layer to the water table) will be evaluated as part of the Feasibility Study.

2.1.2 Process Equipment

SVE Equipment A subcontractor will supply a SVE unit housed in a walk-in container. The SVE unit will consist of a vacuum pump capable of extracting approximately 100 standard cubic feet per minute (scfm) at a vacuum of up to approximately 24 inches of mercury. These specifications were developed to achieve a minimum radius of influence (ROI) for each SVE well of approximately 30 feet; actual ROIs will be determined during the pilot test. The unit will have an air/water separator, a particulate filter, and vacuum and flow gauges. Spill containment will be provided for the air-water separator. A schematic of the SVE pilot system is presented in Figure 2-3.

Vapor Treatment Based on soil vapor data collected to date, total VOCs (including Freons) in the range of 3,500 to 4,000 milligrams per cubic meter (mg/m^3) and Freons in the range of 2,000 to 2,500 mg/m^3 may be encountered. The initial VOC concentrations will decrease substantially over time of SVE operations, therefore, two vapor treatments will be tested: GAC and a condensation-based technology supplied by GEO Inc. A condenser unit is a desirable alternative to thermal oxidation for high VOC concentration treatment (due to potential negative public perception issues regarding thermal oxidation).

GAC will be used to treat vapors for the majority of the test, with approximately two weeks of testing for the condensation unit during the multi-week testing. When the condensation treatment system is tested, it is likely that a different SVE blower unit will be used for that time. That is, the condensation pilot unit will be provided as a complete package to perform SVE and vapor treatment. The SVE unit associated with the condensation unit will also be capable of providing at least 100 scfm and 24 inches of mercury vacuum capacity. As shown on Figure 2-4, the condensation unit will have GAC as a polishing step prior to atmospheric discharge. If dilution air is needed, a flow meter will be used to measure the flow of dilution air.

GAC treatment results from before and after the condensation testing will be compared to the condensation treatment results to compare the two treatments under similar influent conditions.

The following describes how the condensation technology operates (more detail is provided in Appendix A):

- Soil gas is drawn into the system and delivered to an air compressor by a 5- to 10-horsepower positive displacement blower.

- Entrained liquids are separated at a water knockout tank.
- Process air is compressed to10 atmospheres (atms) by a compressor and then cooled to approximately 40° F in an after-cooler.
- Water vapor is removed from the process stream at air-to-air heat exchangers.
- Gas and vapor stream temperature is reduced to approximately -50° F in refrigerated heat exchangers, where the majority of the chemical constituents are condensed and separated from the vapor stream.
- Process gas and vapor stream is then sent to a regenerative adsorber, which removes remaining contaminants and water vapor and directs it back to the inlet stream.
- The air stream [<10 parts per million by volume (ppmv)] is finally polished by granular activated carbon (GAC) prior to discharge to atmosphere at <1 ppmv.

The effluent of the adsorber unit is constantly monitored with an organic vapor analyzer (OVA). The unit can be used in similar applications for many years without fouling or degradation. If it should become fouled, the OVA will detect this and it can be replaced. The spent adsorbent will be removed by a GAC manufacturer and recycler.

Power requirements for the 100 cfm condenser system are:

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- 440 VAC 3 phase 100 AMP plus 220 VAC single phase 60 AMP or
- 220 VAC 3 phase 150 AMP

Actual power consumption is approximately 40 KVA/month. The GEO system is designed to operate 24 hours a day unattended. The system will automatically shut down if power fluctuations or internal malfunctions (e.g., high gas temperature after the air compressor, high temperature prior to regeneration system, high liquid levels in the knock-out water container, the separate phase liquid container and the condensate container, high pressure shutoff prior to condensing system, or high pressure shutoff prior to VOC collection drums) occur.

Spill containment will be provided for the air-water separator and water tank. Flame arrestors are not necessary as the VOCs to be recovered are not flammable (with the exception of a few VOCs that will be present in trace amounts).

Deleted: A schematic of the vapor treatment system is presented in Figure 2-4.¶

2.2 Test Procedures

This section describes the locations, frequency, and parameters that will be monitored during the testing. Sampling methods and frequencies are described in Section 3.

2.2.1 Pre-Test Measurements

Prior to beginning the SVE testing, pre-test subsurface pressure readings and photoionization detector/flame ionization detector (PID/FID) measurements will be taken at all SVE/monitoring wells.

2.2.2 Test Measurements

A step test will be performed at each of the ten SVE wells. Step testing will begin with dilution air feed only (no vacuum applied to the wells and atmospheric air pulled through the pump). The first step will correspond to an applied vacuum of approximately 12 inches of mercury at the wellhead, with subsequent steps at approximately 15 and 18 inches of mercury per well. These vacuum levels may be modified based on the achievable vacuum levels observed at the beginning of the test. Subsurface pressure will be measured at each non-operating SVE/monitoring well to estimate the zone of influence during each step. A given step will continue until pressure readings in the monitoring wells have stabilized to a degree that is reasonable given the duration of each step test (anticipated to be 1 day). The extracted vapors will be monitored with a field PID/FID during the step tests to estimate the total VOC removal rate over time.

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During a minimum of two of the step tests, transient vacuum readings will be taken to allow for calculation of intrinsic permeability of the soils. The treatment zone will initially be defined as that volume of soil surrounding the SVE well where at least 0.05 inch of water vacuum is established. During design, this definition may be refined based on the test results.

The remainder of the test will consist of operating the vacuum pump at a vacuum that targets the selected flow rate from the step testing results. This flow rate will be selected such that the treatment zone size is maximized and the associated applied vacuum could practically be provided on a full-scale system (i.e., this will not necessarily just be the maximum vacuum that the pilot pump can produce, as the pump performance curve and step test results will be considered together). This portion of the test is intended to define the VOC mass removal time trend in extracted vapor and defining the vacuum distribution in the surface as it reaches equilibrium. In addition to continued monitoring of the extracted vapors with the field PID/FID, samples of the extracted vapors and the treated vapors will be collected in Summa canisters for offsite laboratory analysis of VOCs (see Section 3.2.1). It is anticipated that the extended testing period will also include multiple well operation. In addition, additional wells may be installed and tested during this portion of the test (see Section 5.5).

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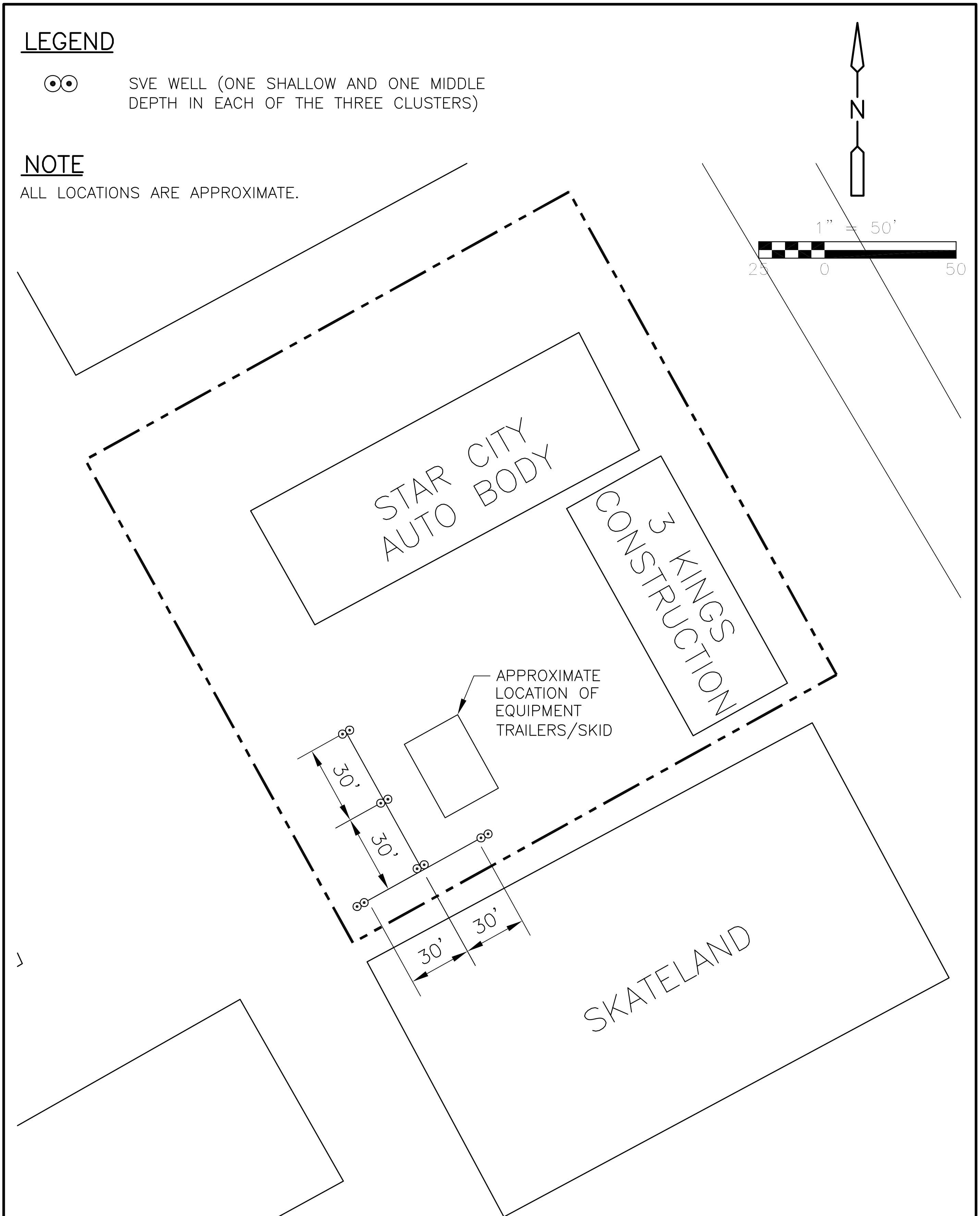


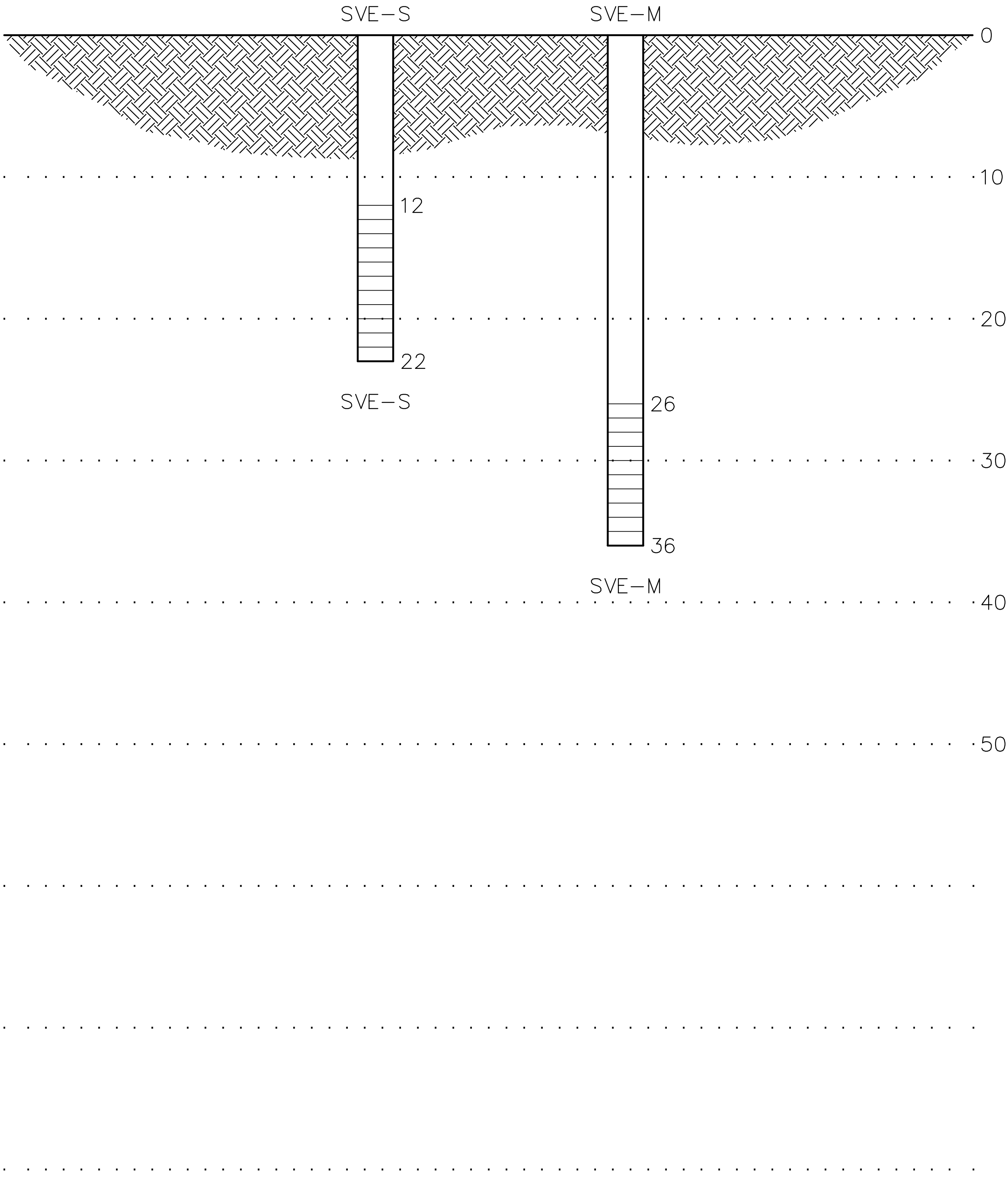
S:\10500\37240\ FIG 2-1 08/01/06 16:31 simpsonkc XREFS: OMEGA_NAD83Z5

OMEGA CHEMICAL

Proposed Layout of Pilot Test SVE / Monitoring Wells

CDM

Figure 2-1



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OMEGA CHEMICAL

Proposed Screened Intervals for SVE / Monitoring Wells

CDM

Figure 2-2

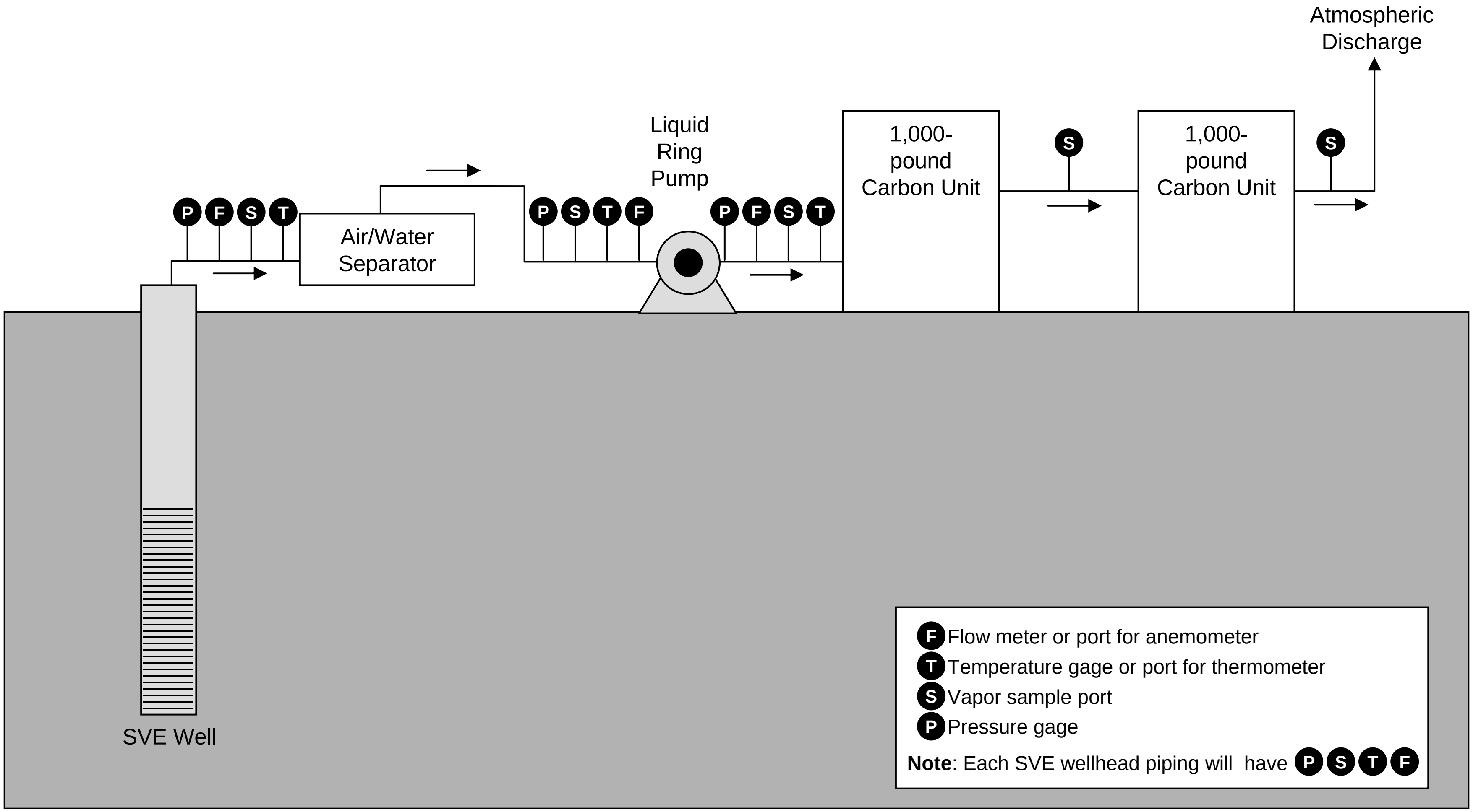

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Figure 2-3
Schematic of SVE Pilot System

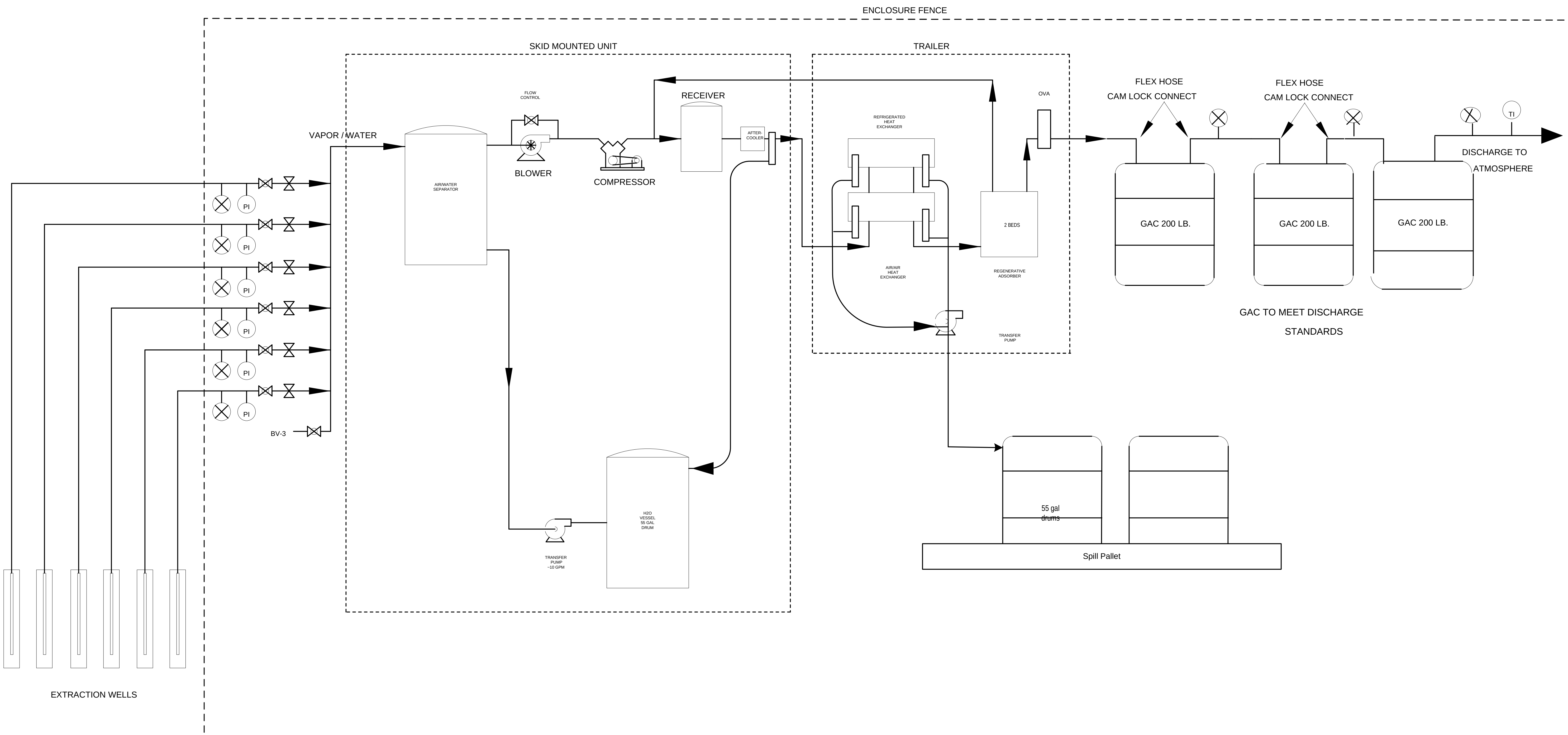

Figure 2.4 Vapor Treatment Schematic

Section 3
Sampling and Analysis Plan

This section describes the data quality objectives (DQOs), monitoring equipment, and monitoring methods that will be used during the pilot testing.

3.1 Data Quality Objectives

Data quality objectives are qualitative and quantitative statements that specify the quality of the data required to support decisions made during testing activities. DQOs are based on the end uses of the data to be collected.

Field and analytical data can be used for a vast number of purposes ranging from qualitative field screening data to quantifiable enforcement level data. The EPA has developed two descriptive data categories to assist in the interpretation of data: 1) screening data with definitive confirmation, and 2) definitive data. Screening data are generated by rapid, less precise analytical or sample preparation methods and provide analyte identification and quantification; however, quantification may be somewhat approximate. Definitive data, on the other hand, are generated using rigorous analytical methods, generally EPA-approved reference methods, with confirmation of analyte identity and concentration. Definitive data generate tangible raw data and require additional QA/QC elements, including, but not limited to, QC blanks, matrix spike samples, and performance evaluation (PE) samples.

For pilot tests, the test objectives are typically achieved through the collection and use of screening level data, with a limited amount of definitive data also collected for confirmation.

- The screening data are used to rapidly identify and quantify site conditions and test performance, although the quantification can be relatively imprecise.

- The definitive confirmation data allow for more precise interpretation of screening data.

This approach is supported by the end use of the data, mainly to assess technical feasibility and to ultimately support remedial design. For example, SVE off-gas treatment systems can address a broad range of contaminants and concentrations. Therefore, it is necessary that the SVE test data provide information regarding contaminant types and concentration ranges to be treated.

Considering the above, the objectives of this SVE testing will be achieved through the collection and use of screening data, with some additional data collected for confirmation. Specifically, samples of extracted vapor will be collected and sent for off site laboratory analysis as described in Section 3.2.1 below. Quality Assurance and Quality Control (QA/QC) is discussed in Section 3.3.

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The DQO process is a series of planning steps that are designed to ensure that the type, quantity, and quality of environmental data used in decision-making are appropriate for the intended purpose. The EPA has issued guidelines to help data users develop site-specific DQOs (USEPA 2000). The DQO process is intended to:

- Clarify the study objective
- Define the most appropriate type of data to collect
- Determine the most appropriate conditions from which to collect the data
- Specify acceptable levels of decision errors that will be used as the basis for establishing the quantity and quality of data needed to support the design

The DQO process specifies project decisions, the data quality required to support those decisions, specific data types needed, data collection requirements, and analytical techniques necessary to generate the specified data quality. The process also ensures that the resources required to generate the data are justified. The DQO process consists of seven steps of which the output from each step influences the choices that will be made later in the process. These steps are as follows:

- Step 1: state the problem
- Step 2: identify the decision
- Step 3: identify the inputs to the decision
- Step 4: define the study boundaries
- Step 5: develop a decision rule
- Step 6: specify tolerable limits on decision errors
- Step 7: optimize the design

During the first six steps of the process, the planning team develops decision performance criteria (that is, DQOs) that will be used to develop the data collection design. The final step of the process involves designing the data collection program based on the DQOs. A brief discussion of these steps and their application to this work plan is provided below.

3.1.1 Step 1: State the Problem

The purpose of this step is to describe the problem to be studied so that the focus of the study will be unambiguous. To summarize the problem, former solvent recycling activities have resulted in the release of chemicals to groundwater and soils of the Site. Elevated concentrations of Freons, PCE, TCE, and other chlorinated products have been detected in soils and groundwater. These chemicals could potentially have an adverse effect upon human health and the environment.

3.1.2 Step 2: Identify the Decision

This step identifies the questions that the investigation will attempt to resolve, and actions that may take place based on investigation results. The specific objectives of the pilot testing are stated in Section 1.5. The goal of this work plan is to provide the methods and guidance to develop the data necessary to support these objectives.

The following are principal questions addressed by the activities described in this work plan:

- Is SVE a feasible technology for the site?
- If feasible, what are the design parameters for a full-scale SVE system?

Actions that <u>could</u> result from resolution of these questions:

- Design and installation of a SVE system at the site (following preparation of the FS)

The decision statement for this investigation is to generate data sufficient to support the FS regarding SVE.

3.1.3 Step 3: Identify the Inputs to the Decision

The purpose of this step is to identify the information and measurements needed to support the decision statement. This is determined by the data uses. Data will be used to achieve the following:

- Estimate the treatment zone sizes for SVE wells screened at different depths at various levels of applied vacuum
- Estimate chemical concentrations in extracted vapors to support selection and design of an appropriate vapor treatment technology
- Determine the VOC mass removal rates via SVE at two depths
- Based on data uses and availability, the following primary data are needed:
- Soil vacuum distribution during SVE operation
- VOC concentrations in extracted vapors from SVE wells screened at different depths
- Relationship between applied vacuum and extraction rate

3.1.4 Step 4: Define the Boundaries of the Study

This step defines the time periods and spatial area to which decisions will apply and determines when and where data should be collected. Information describing the spatial boundaries of the site is provided in Section 1.2. Section 3.0 describes sampling locations and the schedule of investigation events is discussed in Section 5.5.

3.1.5 *Step 5: Develop a Decision Rule*

The purpose of this step is to define the parameters of interest, specify the action level, and integrate previous DQO outputs into a single statement that describes a logical basis for choosing among alternative actions.

As described in previous sections, the purpose of this investigation is to provide data for use in the FS. Parameters of interest are: contaminant concentrations in extracted soil gas and treated vapors, and subsurface vacuum readings.

The following decisions will be based on the data:

If SVE is feasible given site conditions, then determination will be made as to whether the data collected in this investigation are sufficient to support the FS and design phase, if appropriate.

3.1.6 *Step 6: Specify Tolerable Limits on Decision Errors*

Tolerable limits on decision errors, which are used to establish performance goals for the data collection design, are specified in this step.

Section 3.2 discusses the monitoring/sampling design basis and rationale and the quantity of samples to be collected. The quality of data necessary for the purposes of the investigation is also described in the sections below.

3.1.7 *Step 7: Optimize the Design for Obtaining Data*

The work plan was optimized to focus on collection of data based on data uses, availability of historical data, and identified data gaps. The data collection program, including sampling rationale, is presented in the sections that follow.

3.2 Field Equipment and Sampling/Monitoring Procedures

This section describes the field equipment and instrumentation that will be used for monitoring during the testing.

3.2.1 Vapor Sampling

Vapor sampling will consist of on and offsite vapor analysis coupled with the collection of extraction flow rate measurements. For GAC treatment, samples of extracted vapors will be collected for VOC analysis from a sample port on the SVE effluent and from sample ports in between the GAC units and at the effluent of the second GAC unit and from SVE/monitoring wells. For condensation treatment, samples will be collected from the SVE blower effluent, the condenser effluent, and between ant he effluent of the GAC polishing units. Samples will be analyzed for VOCs on site with a field PID/FID and selected samples will be sent off site in summa canisters for laboratory analysis. Samples from a wide range of PID/FID readings will be chosen for laboratory analysis so that relationships can be developed between total VOCs detected in the laboratory and the PID and FID readings.

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Onsite Vapor Quality Measurement

A field PID/FID will be used to frequently measure the total VOC concentration in the vapor samples. The PID/FID will be used to "sniff" the extracted vapor concentration at the SVE sample port, or the vapors within the wells during SVE operation. Sampling frequency for the PID/FID is given in Table 3-1.

Offsite Vapor Quality Measurement

To gather definitive data on the VOC concentrations in extracted vapors, samples will be collected from the SVE and vapor treatment vapor sample ports in Summa canisters (volume one liter or less) for off Site analysis at Air Toxics (Folsom, CA) according to EPA methods TO-15 for VOCs. Vapor sampling frequency for off site analysis is given in Table 3 1.

Vapor Flow/Vacuum Measurement

The total vapor extraction rate from the SVE unit will be monitored by a direct-read, in-line flow meter (approximately 0 to 125 scfm, $\pm$ 2 percent). In addition, flow from each SVE well will be measured within the piping coming from each well. It is anticipated that these measurements will be made with a hand held anemometer or pitot tube/magnehelic gage. The extraction vacuum will be measured at the SVE wellhead using a vacuum gage (0 to 30 inches of mercury, $\pm$ 1 percent). All vacuum gages will be synchronized to a common zero reading prior to use. The flow rate and wellhead vacuum measurement frequencies are given in Table 3-1.

3.2.2 Subsurface Static Pressure Measurement

During the multi-week test, subsurface static pressure readings will be taken from the SVE/monitoring wells using a magnehelic gage. Each well will be fitted with an airtight fitting that allows for the attachment of the magnehelic gage without loss of vacuum within the point. The frequency for measuring subsurface static pressure is given in Table 3-1. During at least one test, transient pressure data will be collected at an appropriate well to provide additional data to calculate the average intrinsic permeability of the Site soils.

3.2.3 Barometric Pressure Measurement

Barometric pressure fluctuations can affect the subsurface static pressure during testing. A barometer ($\pm$ 0.03 inch of mercury) will be on site for monitoring this parameter throughout the testing. The frequency for measuring barometric pressure is given in Table 3-1.

3.3 QA/QC Requirements

This section describes the QA/QC methods that will be used to perform the SVE testing. Additional discussion of QA/QC procedures is provided in Section 7 of the OSS RI/FS Work Plan.

3.3.1 Sampling

Duplicate Samples – Co-located samples will be collected for vapor samples at a minimum frequency of 10 percent.

Trip/Equipment Blanks – A trip/equipment blank will be sent with each shipment of vapor samples (including indoor air samples) sent to the off site laboratory.

3.3.2 Field Instrument Calibration

Field equipment will be calibrated in accordance with the manufacture's instructions. Instruments requiring field calibration will be checked and adjusted before and after each day of use. Calibration results will be recorded in the field and the calibration logs will be included in reporting pilot results.

Table 3-1
Sampling and Monitoring Schedule

Test Phase	Parameter	Location	#/Location	Instrument
Pre-Test	Subsurface Vacuum	All SVE Wells	1	Magnehelic Gage
	Barometric Pressure	Air	1	Barometer
	Vapor VOCs	All SVE Wells	1	Field PID/FID
Pilot Test				
Step Test	Vapor and Dilution Air Flow Rate	SVE Effluent	At least 5/step	Flow Gage
	Wellhead Vacuum	Operating SVE Wellhead	At least 5/step	Vacuum Gage
	Subsurface Vacuum	All Non-Operating Wells	At least 5/step (for transient data, every 15 minutes during the first step)	Magnehelic Gage
	Vapor VOCs	Extracted Vapors	At least 5/step	Field PID/FID
	Vapor VOCs	Extracted Vapors	1 at the end of each step test	Off Site Lab
	Vapor VOCs	Vapor Treatment Effluent	1/day	Off Site Lab
	Barometric Pressure	Air	At least 3/day	Barometer
Multi-Week Test				
	Vapor and Dilution Air Flow Rate	SVE Effluent and Each Operating Well	1/day	Flow Gage
	Wellhead Vacuum	Operating SVE Wellhead	1/day	Magnehelic Gage
	Subsurface Vacuum	All Non-Operating Wells	1/day	Magnehelic Gage
	Vapor VOCs	All Non-Operating Wells	1/week	Field PID/FID
	Vapor VOCs	Extracted Vapors	1/day	Field PID/FID
	Vapor VOCs	Extracted Vapors	1/week	Off Site Lab
	Vapor VOCs	Vapor Treatment Effluent	1/week	Off Site Lab
	Barometric Pressure	Air	2/day	Barometer

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Section 4
Analysis and Interpretation of Test Results

This section describes the data analysis, interpretation, and reporting methods that will be used in evaluating the SVE test results. The data and measurements collected during the SVE testing will provide the following information relevant to SVE performance and remedial design:

- VOC mass removal rate via vapor extraction from two depth intervals
- Zone of influence of the SVE wells in two depth intervals
- Airflow rates that can be achieved at various applied vacuum levels
- Type and concentration of VOCs in extracted vapors and in vapor treatment effluent samples to support treatment system selection to meet South Coast Air Quality Management District (SCAQMD) emission requirements for site contaminants

4.1 Data Analysis and Interpretation

Data collected from the SVE testing will be evaluated to support the objectives of the test, including:

- Atmospheric discharge limitations
- Subsurface pressure data will be used to estimate the SVE zone of influence at various levels of applied vacuum
- Vapor extraction rates and wellhead vacuum levels will be used to size SVE pumps for the full-scale system
- Vapor VOC data will be used to evaluate and size vapor treatment systems
- Site construction limitations

4.2 Reporting

CDM will prepare and submit a SVE Pilot Test Technical Memorandum (TM) approximately 4 weeks after completion of the testing to allow availability of all analytical results for inclusion in the TM. The TM will contain a summary of the methods used in the testing and any deviations from this work plan that occurred during the testing. It will present the results, an interpretation of the results with regard to SVE design, as well as laboratory reports and relevant maps, tables and figures.

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Section 5
Additional Issues

5.1 Health and Safety

Health and safety procedures will conform to the existing Site Health and Safety Plan for the site. It is anticipated that the pilot testing can be completed using Level D personal protection.

5.2 Permitting

The pilot testing will be performed under substantive compliance with SCAQMD permit requirements for SVE operating with GAC vapor treatment. For operations with the condenser vapor treatment, the equipment supplier's (GEO Inc.) multi-site air discharge permit issued by SCAQMD (Appendix A) will be used. These are the only anticipated permits needed to perform the testing.

5.3 Residuals Management

The anticipated residuals from this testing include drill cuttings from well installation, spent GAC and condensed liquids from the vapor treatment unit. Drill cuttings will be drummed and temporarily stored on-site, and labeled as investigation-derived waste pending receipt of the pre-disposal sample results. If cuttings are determined to be hazardous, they will be transported (accompanied by hazardous waste manifests) to an approved facility for disposal. If determined to be non-hazardous, cuttings will be transported to an approved disposal facility, such as a Class III landfill for soils. Spent GAC will be regenerated or disposed of off-site by the vendor. Condensed liquids will be recycled or disposed of off-site.

5.4 Staffing

CDM staff will direct the pilot testing with a subcontractor providing equipment and an operator for test startup. Sharon Wallin of CDM's Irvine office will be project manager and Dave Chamberlin of CDM's Denver office will be the client officer. John Eisenbeis of CDM Denver will serve as technical director for all work discussed herein, and will be the lead author for the pilot test TM.

5.5 Schedule

The schedule for implementation of the SVE testing is contingent upon obtaining access from the property owner and tenant at 3 Kings Constructions, scheduling drillers and equipment suppliers, and obtaining EPA approval of this work plan. It is anticipated that the wells will be installed approximately one week following EPA approval of this work plan and upon gaining all appropriate access. Testing will likely then begin the following week, assuming all equipment is available. It is anticipated that the initial testing will be performed over a period of 3 weeks. The anticipated sequence and duration of tests follows:

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- Setup/shakedown (1 day)
- Step testing of all five shallow SVE wells (5 days)
- Step testing of all five 30 foot sand SVE wells (5 days)
- Testing of shallow and 30 foot sand SVE wells together (4 days)

Following this initial testing, the SVE wells will be operated in various combinations (two adjacent wells at the same depth, and two adjacent wells at different depths) for several weeks to gather data regarding longer term mass removal rates. Two of these additional weeks will be used to test the condensation technology for vapor treatment. In addition, the multi-week testing may include SVE operations at additional locations onsite. Depending on the results of the first two weeks of testing, OPOG may propose to install additional SVE/monitoring wells like the ones described in this work plan in other portions of the Site. With EPA approval, the multi-week testing would then be extended to operate these other wells with the intent of determining whether there are significant differences in extracted vapor composition and/or concentration, and whether there are significant differences in the achievable ROI in the two depths of the subsurface tested.

Figure 5-1 presents a preliminary schedule for tasks associated with the testing.

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Figure 5-1. Pilot Test Schedule

	Week After Work Plan Approval															
Task	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**15**	**16**	**17**
Procure Equipment																
Install Wells																
Initial Testing																
Extended System Operation/Demob																
Prepare Draft TM																
EPA Review of TM																
Prepare Final TM																

Section 6
References

CDM 2003. *Report Addendum for Additional Data Collection in the Phase 1a Area*. June 27.

CDM 2003. *On-Site Soils Remedial Investigation/Feasibility Study Work Plan*. September 29.

CDM 2004. *On-Site Soils Work Plan Addendum, Scope of Work for Additional Investigation*. October 20.

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Appendix A

VAPOR RECOVERY SYSTEM AND PERMIT

A pre-permitted 100 scfm compression-condensation SVE recovery system (G.E.O. WS-100) will be used for the extended SVE pilot test / remediation. The compression-condensation system uses a skid mounted blower/compressor assembly to extract and compress the soil vapor to approximately 150 psi. Prior to entering the blower/compressor assembly, the influent vapor is routed through a water knock-out drum, where entrained water is captured. The compressed vapors are stored in a receiver vessel, then cooled to near ambient temperatures with an aftercooler. The compressed vapor is routed from the aftercooler through a series of air/air heat exchangers and refrigerated heat exchangers which sequentially chill the vapor to an approximate temperature of -45 degrees F. Water vapor and VOCs are condensed and collected in stainless steel condensate drains at this stage. Two types of fluid wastes are produced by the compression-condensation system: 1) an aqueous waste that, based on profile analyses, contains low concentrations of dissolved VOCs in water, and 2) a free-phase solvent liquid that may be eligible for recycling/reuse. The fluid wastes are collected in DOT-specification 55-gallon drums staged on top of spill-containment palettes.

Following the refrigeration stage of the treatment process, the remaining vapors are routed through a proprietary regenerative adsorber, followed by carbon polishing. The system effluent is monitored by organic vapor sensors that are connected to the main system controls. The sensors automatically shut the system off in the event that effluent concentrations exceed the South Coast Air Quality Management District (SCAQMD) permit limits. The operation of the aforementioned compression-condensation recovery equipment is permitted under a SCAQMD Various Locations permit.

Electrical service to the compression-condensation system consists of 3-phase 480 volt and single phase 220 volt service. A licensed electrician will establish a connection to the facility’s main electrical panel, and install the necessary transformer if required, circuit breakers, and outlets.

This initial permit must be renewed ANNUALLY unless the equipment is moved, or changes ownership. If the billing for annual renewal fee (Rule 301.f) is not received by the expiration date, contact the District.

Legal Owner or Operator: G.E.O. INC
1605 W SUMAC LN
ANAHEIM, CA 92802

ID 109002

Equipment Location: VARIOUS LOCATIONS IN SCAQMD

Equipment Description:

SOIL-VAPOR-EXTRACTION AND TREATMENT SYSTEM CONSISTING OF:

1. EXTRACTION WELL
2. WATER KNOCKOUT TRAP, 55 GALLONS
3. EXTRACTION BLOWER, 25 H.P., MAXIMUM FLOW RATE 200 CFM.
4. VAPOR RECOVERY SYSTEM CONSISTING OF:
   A. RECEIVER, 80 GALLON CAPACITY
   B. AFTERCOOLER, 130,000 BTU PER HOUR
   C. TUBE IN SHELL (AIR/AIR) HEAT EXCHANGER
   D. TUBE IN SHELL (REFRIGERATED) HEATED EXCHANGERS.
   E. REFRIGERATED CONDENSER, TECUMSEH, MODEL NO. CL13A692CA, 6900 BTU PER HOUR.
   F. COALESCING FILTER, HANKISON, MODEL NO. A100-0BF-48
   G. REGENERATIVE ADSORBER
5. CARBON ADSORBER, CARBTROL, MODEL G1-200, WITH 200 POUNDS OF ACTIVATED CARBON.

Conditions:

1. OPERATION OF THIS EQUIPMENT SHALL BE CONDUCTED IN ACCORDANCE WITH ALL DATA AND SPECIFICATIONS SUBMITTED WITH THE APPLICATION UNDER WHICH THIS PERMIT IS ISSUED UNLESS OTHERWISE NOTED BELOW.

2. THIS EQUIPMENT SHALL BE PROPERLY MAINTAINED AND KEPT IN GOOD OPERATING CONDITION AT ALL TIMES.

3. THE EXTRACTION BLOWER SHALL ONLY BE OPERATED WHEN ALL THE EXTRACTED VAPORS ARE VENTED BY THE VAPOR RECOVERY UNIT AND THE CARBON ADSORBER, AND

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CONTINUATION OF PERMIT TO OPERATE

WHEN THERE ARE NO DETECTABLE LEAKS BETWEEN THE OUTLET OF THE BLOWER AND THE OUTLET OF THE VAPOR CONTROL SYSTEM.

4. AN IDENTIFICATION TAG OR NAME PLATE SHALL BE DISPLAYED ON THE EQUIPMENT TO SHOW MANUFACTURER MODEL NO. AND SERIAL NO. THE TAG(S) OR PLATE(S) SHALL BE ISSUED BY THE MANUFACTURER AND SHALL BE ADHERED TO THE EQUIPMENT IN A PERMANENT AND CONSPICUOUS POSITION.

5. CURRENT CONTACT PERSON NAME, COMPANY AND PHONE NUMBER SHALL BE DISPLAYED IN A PERMANENT AND CONSPICUOUS POSITION.

6. THE SCAQMD SHALL BE NOTIFIED IN WRITING OF THE FOLLOWING INFORMATION AT LEAST FIVE DAYS PRIOR TO OPERATING OF THE EQUIPMENT AT THE NEW LOCATION:

   A. THE LOCATION WHERE THE EQUIPMENT WILL BE OPERATED.
   B. THE ESTIMATED CALENDAR TIME THE EQUIPMENT WILL BE OPERATED AT THE LOCATION, AND
   C. ALL OPERATING RECORDS REQUIRED AT THE PREVIOUS LOCATION.

   NOTIFICATION SHALL BE ADDRESSED TO:

   SCAQMD
   RULE 1166 COMPLIANCE SECTION,
   STATIONARY SOURCE COMPLIANCE
   21865 E. COPLEY DR.
   DIAMOND BAR, CA. 91765-4182

7. THIS EQUIPMENT SHALL NOT BE OPERATED MORE THAN 12 MONTHS AT ANY ONE LOCATION IN THE DISTRICT.

8. A COPY OF THIS PERMIT SHALL BE PRESENT AT THE SITE.

9. A FLOW INDICATOR SHALL BE INSTALLED AND MAINTAINED AT ALL INLET STREAMS TO THE VAPOR CONTROL SYSTEM TO INDICATE THE TOTAL AIR FLOW RATE IN CUBIC FEET PER MINUTE (CFM). THE TOTAL FLOW RATE SHALL NOT EXCEED 200 CFM. IN CASE A PRESSURE SENSOR DEVICE IS USED IN PLACE OF THE FLOW INDICATOR, A CONVERSION CHART SHALL BE POSTED ON THE EQUIPMENT TO INDICATE THE CORRESPONDENT FLOW RATE, IN CFM, TO THE PRESSURE READING.

10. THIS EQUIPMENT SHALL ONLY BE USED TO EXTRACT AND TREAT VAPORS FROM SOILS CONTAMINATED WITH CHLORINATED SOLVENTS (AND THEIR BY-PRODUCTS) AND BTEX's COMPOUNDS.

11. VOLATILE ORGANIC COMPOUND (VOC) CONCENTRATION SHALL BE MEASURED AT THE INLET AND OUTLET OF THE CARBON ADSORBER AND THE INLET TO THE VAPOR RECOVERY SYSTEM AT LEAST ONCE EVERY OPERATING DAY FOR THE FIRST 7 DAYS OF OPERATION, THEN ONCE EVERY 7 DAYS OF OPERATIONS THEREAFTER, BY USING A FLAME IONIZATION DETECTOR OR A DISTRICT APPROVED ORGANIC VAPOR ANALYZER (OVA)

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CONTINUATION OF PERMIT TO OPERATE

CALIBRATED IN PARTS PER MILLION BY VOLUME (PPMV) OF METHANE ADJUSTED TO PERCHLOROETHYLENE OR TRICHLOROETHYLENE.

12. VOLATILE ORGANIC COMPOUND (VOC) CONCENTRATION SHALL BE MONITORED AT THE OUTLET OF THE REGENERATIVE ADSORBER CONTINUOUSLY, BY USING A FLAME IONIZATION DETECTOR OR A DISTRICT APPROVED ORGANIC VAPOR ANALYZER CALIBRATED IN PARTS PER MILLION BY VOLUME (PPMV) OF METHANE ADJUSTED TO PERCHLOROETHYLENE OR TRICHLOROETHYLENE.

13. THE VOC INLET CONCENTRATION TO THE VAPOR RECOVERY SYSTEM SHALL NOT EXCEED 30000 PPMV.

14. THE VOC OUTLET CONCENTRATION OF THE REGENERATIVE ADSORBER SHALL NOT EXCEED 100 PPMV.

15. THE VOC OUTLET CONCENTRATION FROM THE CARBON ADSORBER SHALL NOT EXCEED 2 PPMV.

16. EQUIPMENT SHUTDOWN INTERLOCKS SHALL BE PROVIDED FOR WHEN THE VOC CONCENTRATION EXCEEDS THE LEVEL STATED IN CONDITION NO. 14.

17. THE CARBON ADSORBER SHALL BE REPLACED WITH FRESH ADSORBENT WHEN THE VOC CONCENTRATION MEASURED AT THE OUTLET OF THE CARBON ADSORBER EXCEEDS THE VALUE LISTED IN CONDITION NO. 15.

18. THE ACTIVATED CARBON USED IN THE PRIMARY AND SECONDARY ADSORBER SHALL HAVE A CTC NO. NOT LESS THAN 60% AS MEASURED BY ASTM METHOD D3467.

19. RECORDS SHALL BE MAINTAINED TO PROVE COMPLIANCE WITH CONDITIONS NO. 7, 10, 11, 12, 13, 14, 15 AND 17. THE RECORDS SHALL BE KEPT FOR AT LEAST TWO YEARS AND MADE AVAILABLE TO DISTRICT PERSONNEL UPON REQUEST.

ORIGINAL

21865 East Copley Drive, Diamond Bar, CA 91765

PERMIT TO OPERATE

CONTINUATION OF PERMIT TO OPERATE

NOTICE

IN ACCORDANCE WITH RULE 206, THIS PERMIT TO OPERATE OR A COPY SHALL BE POSTED ON OR WITHIN 8 METERS OF THE EQUIPMENT.

THIS PERMIT DOES NOT AUTHORIZE THE EMISSION OF AIR CONTAMINANTS IN EXCESS OF THOSE ALLOWED BY DIVISION 26 OF THE HEALTH AND SAFETY CODE OF THE STATE OF CALIFORNIA OR THE RULES OF THE AIR QUALITY MANAGEMENT DISTRICT. THIS PERMIT CANNOT BE CONSIDERED AS PERMISSION TO VIOLATE EXISTING LAWS, ORDINANCES, REGULATIONS OR STATUTES OF OTHER GOVERNMENT AGENCIES.

EXECUTIVE OFFICER

Dorris M. Bailey

By Dorris M. Bailey/rdo
8/23/1996

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